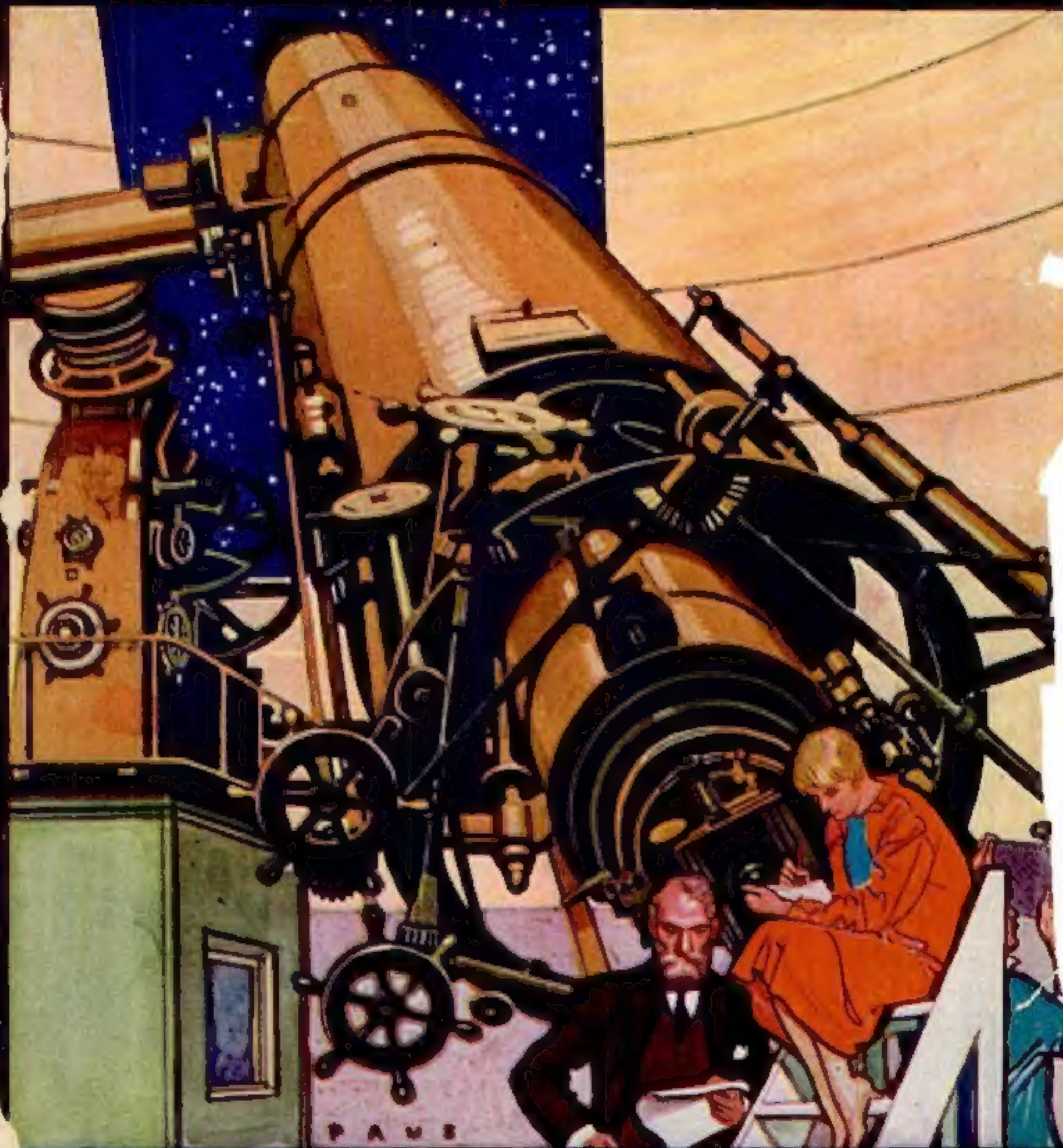


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WHAT IS NEW THIS MONTH

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"THE MOVIE MAKER"**A Thrilling Novel of Men Who Work Miracles Behind the Screen**

Zero hour! Over the trenches with fixed bayonets—running, stumbling, falling across No Man's Land, the gray dawn lit with red flashes or darkened by rolling dirt clouds as big shells plow into the earth and bury the living and the dead—

Yet not a man lost on either side! For the battlefield is a silver screen and the tall trees uprooted by shells are only two feet high. But the doughboys are real men, not pygmies.

HOW DO THEY DO IT?

In this surprising aerial story, starting in next month's issue, you will be told exactly how motion picture producers perform their wonders by technical and camera trickery. Instead of looking at a motion picture screen, you will see behind that mirror of shadow and light—view the movies from the inside. The most jealously guarded technical secrets will be revealed and all told in a vivid story that will carry you along by its swift action and fascinating characters.

You Can't Afford to Miss It

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Announcing

THE NEW BUSINESS FIRM

"GEORGE CASTLE & FAMILY"

How every man may have his own business without changing his job

By WALLACE AMES, Financial Editor

WELL, we did our Christmas shopping early, but—Oh! Boy—how broke we are now! Gee! I hope I get a raise the first of the year. If I was sure of it I would plan a little party down on Broadway New Year's Eve, but as it is I guess our family will have to celebrate by going to bed."

It was George Castle talking to his very good friend and neighbor, Fred Flint, as they rode out on the commuting train one evening.

"There you go again," reproved Fred. "In one breath you complain of being broke and in the next figure how you would blow in more money if you had it. What would your idea of a New Year's Eve party cost?"

"Maybe a century," carelessly estimated George.

"That's a lot of money for one evening's fun, especially for a man in your situation. Seeing as you haven't got the spare hundred to blow in, and since I wouldn't get much fun out of that sort of party anyway, let's plan to celebrate together at home. Bring your wife over to our house and we'll plan a party that won't cost a lot," suggested Fred. "Maybe some of the neighbors will come in. We'll turn on the radio and get all the racket we want."

"And that reminds me," said Fred, as they reached their "door step," "with New Year's and resolution time nearly here there is something I was going to suggest to you, being as we are such good friends. How would you like to go into business for yourself, beginning January 1st?"

"What's the use of me talking about that? You know I haven't any money piled up," George replied.

"That's just why I suggested it, George. I have in mind a very profitable business proposition. It does not require any capital to start. Two years ago I went into the same line of business and the dividends have been rolling in ever since."

"You in business?" queried George, considerably puzzled. "Why, you are just a salaried man, like me. Quit kidding."

"I may be a salaried man, but I'm in business for myself just the same," Fred assured him. "Come over after dinner and I'll tell you all about it."

George still thought it was a joke. But like so many others he had dreamed and hoped that some day, in some way (he never tried to figure out how) he would be able to go into business. So he hurried through dinner and went over to Fred's house with his curiosity at high pitch.

"Let's glance at the evening paper," Fred began, as he turned to the Financial Section. "Did you ever look at the earning statements of railroads, industrials or public utilities? Did you ever notice that these reports show what a company has earned after paying interest, taxes, all operating costs and providing for depreciation?"

"By the way, here are reports on two companies that illustrate nicely the point I want to make. These reports show that both companies had substantial gross earnings. But you will observe that after paying all expenses one company has very little left. That is why its stock is paying no dividends. This other company has big net earnings so its stock is paying dividends and its surplus is growing."

"But what has all that got to do with your scheme for me to go into business for myself," interposed George, a little impatiently.

"It has everything to do with my scheme," Fred assured him. "And I am coming right to the point. I hope you will not be disappointed when I tell you that I have been leading up to the suggestion that you go into the Business of Getting Ahead."

"George, up until two years ago I went through much the same financial troubles that you were complaining about on the train this evening."

"We used to manage our family financial affairs like the business whose gross earnings all go to paying expenses of one kind or another, wages, taxes, interest, bad debts and other expenses so that there is nothing left for dividends on capital stock."

"Then I got to thinking it over. I realized that in personal finances, the same as in business, it is only the net that counts. My salary was then \$6500—total expenses \$6500—net gain nothing. I was just giving my time, knowledge and experience to my firm in return for a comfortable existence. And it wasn't so comfortable at that as we were always worrying about money matters."

"Until that time I thought I was earning \$6500 a year. Then I realized that I was not really earning a cent—from the net point of view."

"Then Ruth and I began to consider the matter seriously and we decided to incorporate at an imaginary \$20,000 and pay 6% on our capitalization. That meant we had to revise our overhead so as to save \$1200 a year—\$600 every month. And we did it!"

"The next year I got a \$500 raise. Instead of spending it as we formerly did we decided to raise our 6% dividend rate to 8 1/4%. In other words we decided to save and invest the extra \$500."

"Every year we draw up a memorandum, sort of balance sheet, just for fun, and compare it with the figures for the year before we started to get ahead. Maybe the actual figures will interest you." And Fred brought out a memorandum containing these figures:

	1927	1926	1925
Rent.....	\$1200	\$1200	\$1200
General household expenses.....	1800	1700	1700
Auto operation and maintenance.....	500	400	450

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POPULAR SCIENCE MONTHLY
250 Fourth Ave. New York City

The New Firm of George Castle & Family

(Continued from page 4)

	1927	1928	1929
Clothes for self and family	600	400	450
Insurance, taxes and contributions	300	300	300
Misc. personal expenses	900	500	500
Investments	0	1200	1760
Gain, but unaccounted for	1000	600	500

Total \$6500 \$6500 \$7060

"It wasn't so hard when we got right down to it. As these figures show, all we did was to cut down on expenses where we were not getting anything for our money.

See that old item of \$60 in investments. That's the interest on what we invested the previous year. We are saving the interest too. Some day it will be a real item. Then we may declare an extra dividend and blow ourselves to a big trip. But not for a while. We are going to get a long way ahead first.

"All I wanted to do," concluded George's friendly adviser, "was to set you thinking straight on your earning power. Your earning power is not what you are paid by your company but what you keep and invest out of your income, just the same as the financial strength of a business concern is indicated by its net after expenses are cared for."

"I get your point, and you are right," agreed George, "but I am afraid it will be hard to change our spending habits all at once."

"That is a little detail for you and your wife to handle. All I have left to suggest is this: Before the New Year arrives, you and the talk it all over and establish the firm of George Castle & Family, Specialists in the Business of Getting Ahead. Figure out what dividend you ought to pay on your year's operations and take that money out of your salary as you draw it. Soak it away in some good investments and keep your expenses within the balance of your income.

"In other words, George," said Fred as they parted, "just use the same business sense in your personal financial affairs that you do in attending to your work down town and the new firm of George Castle & Family will be a flourishing business by this time next year."

To Help You Get Ahead

THE Booklets listed below will help every family in laying out a financial plan. They will be sent on request.

"Ideal Investments" is the designation universally accorded Smith First Mortgage 6½% Bonds which carry attractive tax refund features. A history of the House and information relative to their bonds and the safeguards that surround every issue they offer, may be obtained by addressing the home office of The F. H. Smith Company, Smith Building, Washington, D. C.

The House Behind the Bonds reminds the investor of the importance, not only of studying the investment, but of checking up the banker who offers it. Address: Fidelity Bond & Mortgage Co., 1185 New York Life Building, Chicago, Ill.

Behind the Scenes Where Bonds Are Made tells how you can retire in fifteen years and have an income equal to your present living budget. This booklet can be secured by writing to Cochran and McCluer Company, 46 North Dearborn Street, Chicago, Ill.

Thirty-two page illustrated booklet, describing one of the largest public utility companies, of interest to investors. Utility Securities Company, 230 S. La Salle St., Chicago, Ill.

The Common-Sense Test of Investment Trusts suggests an easy method by which you may correctly judge the worth of any investment trust before putting your money into it. United States Fidelity Corporation, 50 Broadway, New York, will send a free copy if you request Circular C5.



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An AUTHORITY Answers Your Questions on Oil Heating

EVERY day, by mail and by phone, questions on oil heating are constantly being put to the Popular Science Institute of Standards. There appears to be a tremendous interest in this modern method of heating, and it also seems that there are certain points which need to be cleared up with regard to the subject.

The same questions are asked repeatedly, and in answering some of these in this article, we are covering the major points that should be known about oil heating in general.

What are the advantages of heating with oil? A good oil heating plant, properly installed, will give a degree of satisfaction not possible with coal in so far as convenience, freedom from attention, shoveling and sifting of ashes is concerned. It also provides a constant, even, and clean heat.

Is it going to cost me more to use oil as fuel? In sections of the country where coal and oil prices are on a par, heating with oil generally costs the same or slightly more than coal. There are cases where there is a considerable saving in heating with oil, but as a rule no economical advantage can be expected from using this type of fuel.

How much servicing is required? A good oil heating plant needs little servicing. Some adjustment or repair may be necessary at rare intervals, but no regular attention is required.

How about the danger from fire that I hear about? It has been proved that oil as a domestic fuel is as safe to use as anthracite coal, and several times safer than bituminous coal. An oil burner listed by the Underwriters' Laboratories and properly installed according



By COLLINS P. BLISS

Consulting Mech. Engineer, U. S. Bureau of Standards, Washington
Head of Dept. of Mech. Engineering, New York University
Director, Popular Science Institute of Standards

to specifications offers no danger from fire. The fires you hear about almost never occur in such installations. Often fires that are attributed to oil heaters are started from some other cause.

What chance is there of an oil shortage? It is certain that the oil practi-

cally in sight at this time is enough to supply all probable needs for a period of twenty years. Also, there is no telling at the present just what will be done in the way of developing new processes of securing fuel oils or what new sources may be found.

Would it be wise to wait a while before installing oil heat? Many people fear that this type of heat is still in the experimental stage and not capable of giving satisfaction. While oil burners today are not perfect, there are now devices on the market that seem, from the standpoint of our present knowledge, to be very near perfection. Just what advancement may be made is doubtful.

Is oil heating worth the cost? The best answer to this is that few high grade oil heating systems are removed. The majority of owners of such plants report they would be willing to pay considerably more for oil before going back to coal.

The Popular Science Institute of Standards has made a very comprehensive survey of oil heating, questioning 3345 oil burner owners in 232 cities of thirty different states. On the basis of the findings, the Institute has been able to approve certain burners that have been definitely found to be giving satisfaction.

SPECIFIC recommendations and general advice on oil heating can be had from the Institute by those POPULAR SCIENCE MONTHLY readers who write us advising (a) number of rooms in house, (b) type of heating system, (c) average annual coal consumption, (d) whether gas and electricity are available. Address the Popular Science Institute, 250 Fourth Ave., New York, N. Y.

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THE PUBLISHERS

Battery or Electric Power?



Licensed under Andrew-Hammond patent

Balkite AB Contains no battery. A complete unit, replacing both "A" and "B" batteries and supplying radio current directly from the light socket. Contains no battery in any form. Operates only while the set is in use. Two models: AB 6-135, 135 volts "B" current, \$64.50; AB 6-180, 180 volts, \$74.50.



Balkite "B" One of the longest lived devices in radio. The accepted tried and proved light socket "B" power supply. The first Balkite "B," after 3 years, is still rendering satisfactory service. Over 300,000 in use. Three models: "B"-W, 67-90 volts, \$22.50; "B"-135, 135 volts, \$23.00; "B"-180, 180 volts, \$24.50. Balkite now costs no more than the ordinary "B" eliminator.



Balkite Chargers

Standard for "A" batteries. Noiseless. Can be used during reception. Prices drastically reduced. Model "J," rates 2.5 and .5 amperes, for both rapid and trickle charging, \$17.50. Model "N" Trickle Charger, rates .5 and .8 amperes, \$9.50. Model "K" Trickle Charger, \$7.50.

There are special models for 25-40 cycles at slightly higher prices. Prices are higher West of the Rockies and in Canada.

Which is better for radio?

The answer is that both are good. Both have their advantages. Both will be used for years to come. So Balkite makes both chargers for storage batteries and "A," "B" and "AB" electric power units.

If you buy a Balkite charger you buy the standard charger in the radio field. If you buy Balkite "B" you buy one of the longest lived devices in radio. The first Balkite "B" after 3 years' use is still as good as new.

If you buy Balkite "A" or Balkite AB you buy one of the most popular units Balkite has ever introduced. Both are real electric devices, enabling you to make your set an electric receiver, containing no battery in any form. They never require charging.

Whether you buy a charger or electric radio

power unit if you buy Balkite you will be certain of satisfactory radio reception. Both are based on the famous Balkite electrolytic principle of rectification, a principle now used on over 2,000,000 Balkite units in radio and a score of other industries. A principle that has become standard on the signal systems of most of the railroads of the country. A principle so obviously good that three manufacturers — USL, Gould and Vesta — use it under license in radio alone.

The important point after all is not

whether you buy battery or electric power, but that the one you buy be reliable and good. That if you buy a charger it be one that will not ruin your battery. That if you buy an "electric" unit you really get one that has no batteries in it. Ask your dealer.



Licensed under Andrew-Hammond patent

Balkite "A" Contains no battery. One of the most popular units ever offered by Balkite. The same as Balkite AB, but for the "A" circuit only. Enables owners of Balkite "B" to make a complete light socket installation at very low cost. Price \$33.00.

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Radio Power Units



About 800 B. C. the Greeks sent messages by means of the Ctesibion. In two stations were water jars of equal size in which floated marked rods. On signal by torch or flag, plugs were pulled. When the rods lowered to a certain mark, at another signal both plugs were reinserted. The rods in both towers dropping to the same mark, the message was known.



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PROHIBITION— IS IT GOOD for US?

Two Famous Doctors Disagree on the Effects of the
Dry Law on the Nation's Health and Present
in a Spirited Debate Startling Views
of America's Greatest Problem

NO "The necessity for alcohol may be taken as a natural law of well being for the vast majority of the human family. We thus see that our prohibition friends, by their unwarranted zeal, have succeeded in placing the Constitution of the United States in conflict with the constitution of man."—*Dr. Charles A. L. Reed.*

YES "Beverage alcohol is wholly unnecessary for developing and keeping perfect health. No test has been devised which does not exhibit serious inferiority in functions of muscle, mind or special sense when doses of alcohol are used even in small and apparently ineffective amounts."—*Dr. Haven Emerson.*

AFTER all, what everybody wants to know about prohibition, and what nobody definitely has found out, is its effect upon our physical well being. The public has been fed so much biased opinion and political ballyhoo on the subject, that facts from which to draw reliable conclusions have been lost in the controversy.

Just what is the Volstead law doing to the health of the nation? Is it prolonging lives and generally increasing the physical fitness of the American people? Or, on the contrary, is it undermining health with poisonous concoctions, depriving the bodies of workers of needed fuel for building energy?

Into a recent gathering of the American Public Health Association in Cincinnati, these questions were hurled, setting off a debate of such intensity that it all but broke up the meeting. At the front of the controversy stood two distinguished American medical authorities.

ONE was Dr. Haven Emerson, Professor of Public Health Administration in the College of Physicians and Surgeons, Columbia University, and former Health Commissioner of New York City. He brought an array of medical evidence to substantiate his contention that alcohol, consumed even in moderation, not only is unnecessary to healthful human diet, but is injurious to brain,

nerves and body. And he cited statistics of the American death rate to show that prohibition, by lessening the consumption of alcohol, has improved the general health of American families, especially of women and children.

THE other was Dr. Charles A. L. Reed, of the University of Cincinnati, former president of the American Medical Association and of the Pan-American Medical Congress. Conceding that excessive drinking of alcohol is harmful, and may even result in death, he presented other medical evidence tending to show that alcohol helps to form the very tissues of our bodies, and is required in moderate quantities by most people to keep the human machine running efficiently. He flatly denied that the statistics referred to by Doctor Emerson could be interpreted as a sign of improved public health under the prohibition law.

Here we find two nationally recognized health experts as far apart as the poles on the most widely discussed problem of the day. But at least they replace blind prejudice and guess with thoughtful discussion based on scientific research. With the light of exact science turned on the subject, the facts about prohibition and our health are bound to be revealed.

POPULAR SCIENCE MONTHLY invited Doctor Emerson and Doctor Reed to present their views. Their statements, which

follow, hinge largely on the interpretation of figures showing trends in the death rate of the United States submitted to the Cincinnati meeting by Dr. Louis I. Dublin, Statistician of the Metropolitan Life Insurance Company, form probably the most authoritative scientific discussion of the health aspect of prohibition ever published.

Dr. Dublin's figures were offered, in the absence of reliable statistics on sickness, as the best available index to public health. They show, first of all, that the average death rate over six years of prohibition, from 1921 to 1926 inclusive, was at a lower level than during the period before prohibition, from 1900 to 1917. On the other hand, however, they reveal that the death rate trend has been steadily upward from year to year since prohibition became effective, whereas previously it was downward. Moreover, the general upward trend has been due mostly to increasing deaths among men.

IN DRAWING a comparison between the two periods, Doctor Dublin omitted the years 1918, 1919 and 1920 which, he said, were severely disturbed by the influenza epidemic and therefore gave a false picture of the trend of mortality.

In cold figures, the charts reveal that the average yearly mortality in the U. S. Registration Area, New York, New Jersey, Indiana and the six New England

States, during the period before prohibition was at the rate of 15.13 deaths to every thousand persons, and the mortality was declining at the rate of .10 per thousand each year. In the six years after prohibition, the average dropped to 12.58 per thousand, or 16.9 percent lower than before. But instead of a yearly decline, the death rate climbed .09 per thousand a year—nearly as rapid an increase as was the decrease in the earlier period. Among insurance policy holders the average rate was 26.2 percent lower, and showed a very slight annual decline instead of an increase.

ADDITIONAL data from the Government Census Bureau at Washington revealed that, while the decline in mortality before prohibition included both men and women, since 1921 there has been a marked rise in the death rate among men, and for the most part a stationary condition among women though at a lower level. Doctor Dublin summarized these results as follows.

"The prohibition period is characterized by sharply declining mortality rates among children and adolescents of both sexes, and the decline is continued among women." The improvement is retarded among young male adults and disappears altogether during the middle years of life in that sex. In fact, the mortality has defi-

nately risen among men over thirty five."

The noticeable improvement among young women and children, Doctor Dublin concluded, apparently is partly due to the attack of health and social service agencies against disease, and partly to a rising standard of living.

"Why, then," he asked, "have the death rates for men increased in view of these favorable changes? In that sex we find that an improvement in tuberculosis has gone hand in hand with an increase in the mortality from pneumonia, from accidents, from heart disease and kidney disease. During this period there has been a constant rise in the death rate from alcoholism and from the associated condition of cirrhosis of the liver. Both of these diseases were at a minimum in 1920. They are now at a point almost as high as in the decade prior to prohibition. The picture we have found to exist in the mortality of adult men is entirely consistent with the observations, universally confirmed, of a continued widespread indulgence in alcoholic beverages by men. Prohibition has not been effective in that sex, and especially has this been true in the cities, and more particularly in the Eastern states.

"If the saloon has gone and the great

body of men no longer spend a large part of their wages on liquor, it is only too clear that what they do drink now, even if in smaller quantities, is of such a deleterious character as to result in no advantage in health to them. The quality of liquor used throughout the country is sufficiently bad to make up for the smaller quantity consumed."

DOCTOR DUBLIN presented further figures indicating how prohibition is undermining the health of men. In 1920, the death rate from the use of alcohol reached its minimum—1.3 deaths for every hundred thousand persons. Since then every year has seen a rise, until now the rate is more than three times as high. The year 1920 also showed the very lowest rate for admission to insane hospitals for alcoholism. Last year saw conditions three times as bad.

"It is only too true," he said, "that in the country over, with very few exceptions, there is a mounting rate from alcoholism and from the associated diseases in the male population, and there is no indication as yet of a tendency toward improvement in them."

Such are the figures and conclusions of the expert statistician. Are they a correct

picture of the nation's health under prohibition? It is the opinion of two medical experts, Doctor Emerson and Doctor Reed.



Using a violet camera, Dr. Reed, in the photograph above, is detecting poisons in the soil. The camera is the work of the Massachusetts Institute of Technology. It is a special camera which detects any dangerous ingredients

By **CHARLES A. L. REED, M.D.**

THE effort is being made to show that prohibition is promoting the general health of the American people. This effort is based upon a two-fold fallacy. The first consists in the assumption that prohibition—in the sense of suppressing the manufacture, sale or consumption of alcoholic beverages—is, or has been, an actual fact in any part of the United States. The second fallacy consists in the equally unwarranted assumption that the state of the public health is a determinable fact. The only possible index to the public health is the prevalence of disease. There is no city or state in which diseases, taken as they come, are reported and recorded. It follows, therefore, that those who try to show that prohibition is the cause of improved health are engaged in an utterly hopeless task.

In this dilemma they resort to reasoning beside the point.

On one hand the statistician turns to the mortality rate to prove his thesis. He does this, even in face of the fact that the mortality rate is based chiefly upon deaths from diseases that, so far as their causes are concerned, have nothing to do with the effects of alcohol upon the human system. Thus, the lead-

(Continued in first column, page 11)

By **HAVEN EMERSON, M.D.**

BEVERAGE alcohol (ethyl, or grain alcohol), whatever its strength, is wholly unnecessary for developing and keeping perfect health at any age or in any race, climate, or occupation. Alcohol used medicinally for the sick under physicians' orders for its selective depressant action, and even for supplementary fuel-food purposes, is found to be useful occasionally but to a decreasing extent in the practice of medicine.

If we knew how much alcohol in drinks is now used, and by persons of what ages, and under what conditions of dose and frequency, work, rest, and nourishment, we could with much accuracy allot to this habit its share, if any, in ill health.

Without this information we must rely upon circumstantial evidence that so far has failed to convince people whose social customs have made them regard alcoholic drinks as a safe and indispensable article of diet.

As England's leading physicians and other scientists wrote in their classical report published in 1918, "it is remarkable that throughout the world lack of knowledge upon the action of alcohol on the human organism still prevails, and there is

(Continued in second column, page 11)



Opposes prohibition. Dr. Charles A. L. Reed, Professor Emeritus University of Cincinnati, and noted as a writer of medical subjects, former President of the American Medical Association, and of the Pan American Medical Congress

rate for these years as a curve; however, we discover that if the improvement which preceded 1917 had been traced across the three intervening years it would have connected accurately with the "lower level" line beginning in 1920. It would seem that just here, at the beginning of the Volsteadian period, our statistical expert was about to be hoisted by his own petard. For now the figures show a distinct upward trend. So he at once divides the dead people into two groups, one consisting of women and children whose death rate goes on declining, the other consisting of men over thirty whose death rate goes on increasing. Men under thirty seem to have been lost in the shuffle. From this he infers that the deaths among women and children, who never did drink, have been improved by prohibition, and that deaths among the men above thirty, notorious violators of prohibition, have been increased. At this point, with an air of resignation, he calmly announces that, for improvement in the latter class, it will be necessary to await the advent of the next and nonalcoholized generation. All of which reminds me to observe that figures don't lie. They can't. But they can be juggled.

THE philosophic special pleader of the prohibition brand is a more subtle article. It is his special mission to show that "prohibition" is the fount from which all blessings flow. But he inadvertently fails to concede, what every fair-minded critic of prohibition does concede, that there may be two sides to the account. Thus the fair-minded critic concedes that elimination of the saloon, and the saloon drunkard, stands on the credit side of the ledger. But he insists, what our prohibition philosopher does not concede, that there is a debit side. The latter recognizes that we are in the midst of unparalleled prosperity, which he claims as one of the blessings from prohibition. He points to improved savings accounts as an index of improved prosperity and again gives the credit to prohibition, assuming that the increase in savings is due to the deposit of money that otherwise would have been spent for drink. Then he assumes that the improved general health is due to the improved nutrition that is due to the increased savings deposits that is due to prohibition that is due to the Volstead Act that is due to the Eighteenth Amendment. And there you are! In this way accepting the findings of scientists that suit his purpose, rejecting those that do not, he goes on until he accounts for almost every phenomenon in Nature except, possibly, the homeward flight of the swallows.

There are, however, a number of plain facts that our Volsteadians might have taken into consideration. There is the bald fact, based upon authentic figures, that since the enactment of the Volstead Act, sixty-five thousand American citizens have been done to death by poisoned alcohol. This, I am told, is fifteen thousand more than America lost on the fields of France during the World War. These deaths occurred as a result of the "health-giving" influence (Continued on page 145)

ing causes of death are tuberculosis, pneumonia, heart disease, cancer and the infections of childhood. In making his computation, or comparison, he takes the pre-Volsteadian years between 1900 and 1917 and the post-Volsteadian years between 1920 and 1926. This is justified by the fact that the death rate for the three intervening years was distorted by the world-wide prevalence of influenza. The mortality rate, beginning in 1920, is shown to be on a lower level than during the preceding period. This fact is heralded triumphantly as being due to prohibition. When we plot the death

no authoritative work which gives or seeks to give the required information."

And yet is there not much in their conclusions upon our incomplete present knowledge to help us in answering the question at issue? Is there a hazard to health in the use of beverage alcohol? The wise men of England at perhaps the most critical point in their country's history since the Napoleonic wars gave out in an official government document these brief paragraphs as representing the state of sound knowledge at that time:

"The main action of alcohol (apart from the effects of its continued excessive use)

is confined to the nervous system. Alcohol is a narcotic rather than a stimulant in action.

"Its habitual use as an aid to work is physiologically unsound."

"Its nutritional value is strictly limited by its drug and toxic action."

"The ordinary use of alcohol should not only be moderate, but should also be limited to the consumption of beverages of adequate dilution, taken at sufficient intervals of time to prevent a persistent deleterious action on the tissues."

Perhaps a reason for the widespread misunderstanding as to the real effect of alcohol is hidden in these further excellent descriptions of age-old observations of human conduct as modified by the moderate nonintoxicating use of alcoholic beverages.

"Self-satisfaction is increased, but neither skill nor power. While alcohol gives the drinker the impression that he has performed the allotted task with unusual facility and success, impartial and objective examination of the performance shows (almost) invariably where the higher faculties are concerned that both accuracy and regularity have fallen below normal standard."

No test has yet been devised, from the crudest physical competition of marching troops to the most intricate psychological performances in a perfectly appointed laboratory, which does not exhibit a serious inferiority in the functions of muscle, mind, or special sense, when doses of alcohol are used even in amounts so small that the subject cannot himself notice the effect in his own sensations or performances.

We know from long experience with the sick that resistance to and recovery from conditions such as lobar pneumonia, and septic infection or blood poisoning are reduced by the habitual, though not necessarily excessive, use of alcohol.

WE KNOW that alcohol even in nonintoxicating doses, if habitually used, is responsible for a variety of disturbances of digestion, nutrition and nervous or mental function.

It is hardly necessary to say that in excessive amount or frequency, alcohol causes directly a large number of deaths and indirectly raises the death rate of many diseases and contributes heavily to the sickness in the general and mental disease hospitals.

Furthermore, these statements refer to the use of all kinds of alcoholic beverages in all countries and among all races, the harmful effects applying more especially to women and to children.

Before 1920 we had in this country a crude index of the total amount of alcohol consumed in beverages, but since this commercial traffic was outlawed we have little but the vaguest guesses. Estimates of our present use vary widely, none going beyond twenty percent of the pre-prohibition amount and some falling to but three percent. (Continued on page 145)



Continued

For prohibition. Dr. Haven Emerson, Professor of Public Health Administration in the College of Physicians and Surgeons, Columbia University, and former Health Commissioner of New York City



This simplified diagram illustrating the operation of the Televox shows how various vibrations of tuning forks go over telephone wires to the "mechanical man," which receives them as a code and responds by turning on and off, among others, the devices at the right.

Machines That Think

Electrical "Men" Answer Phones, Do Household Chores, Operate Machinery and Solve Mathematical Problems

By HERBERT F. POWELL

AN ASTONISHED group of engineers in New York City the other day saw an electrical machine answer telephone calls with almost human intelligence and with more than human accuracy. When the bell rang it lifted the receiver, replied to audible queries from the other end of the line, and executed instructions to perform certain mechanical acts, such as switching on lights and starting an electric fan and a vacuum cleaner. The tasks completed, it reported "O.K." and hung up the receiver!

A few days later, mathematicians in the Massachusetts Institute of Technology at Boston "fed" to another electrical machine a difficult problem—an intricate series of equations which would have required weeks and even months for human brains to solve. Switches were thrown, motors turned, and in eight minutes the machine ground out the correct answer in written form.

Machines that can receive, acknowledge and carry out orders! Through the marvels of electrical invention, the "mechanical man" now becomes far more than a fancy.

LOOK first at that uncanny mechanical creature answering the telephone. He is the invention of R. J. Wensley, an engineer of the Westinghouse Electric and Manufacturing Company, and goes by the name of Televox. If you could dissect him you would find his inner workings much like those of your radio receiver, and little more complicated.

Yet if you should establish him at home in your absence—which the inventor says is not at all impracticable—he would serve you as a trustworthy and obedient caretaker.

The mechanism consists primarily of a series of electrical relays, each sensitive to a sound of a certain pitch, and capable of translating that sound into specified mechanical action, such as opening and closing the switches of electrical appliances. Each relay is actuated through a tuned electrical circuit responsive to vibration of a given frequency and no other, somewhat as the circuits of your radio set can be tuned to a broadcasting station of a given wave length.

THE mechanical man is not connected electrically to the telephone, but listens much as you would. His ear is a sensitive microphone placed close to the receiver. His voice is a loudspeaker close to the transmitter. And the language he speaks is a series of mechanically operated signal buzzes.

Experimentally, he has been made to understand and respond to words uttered by human voices, but for practical operation the language which spurs him to action has been simplified to three different sounds of different pitches. These sounds are made either by three tuned pitch pipes or—as in the New York demonstration—by three electrically operated tuning forks.

For illustration, imagine you are at the house of a friend and are calling your home equipped with a Televox. In the ordinary way you telephone your home. When

your phone rings, Televox lifts the receiver and utters a combination of buzzes which tell you that you have the right number.

Now you sound a single high note from the first pipe, which means, "Hello, get set for action." Televox stops buzzing and responds with a series of clicks, saying, "All set, what do you want?"

Next you sound two short notes from the same pipe. These tell Televox to connect you with the switch on the electric oven. The reply is two short buzzes saying, "You are now connected," followed by a long buzz-a-a-a, which informs you that "the switch is open."

At this, you sound a deeper note on the second pitch pipe, meaning "Close the switch and start the oven." Immediately Televox ceases the long buzz, closes the switch, then replies with a short, snappy buzz informing you that the switch has been closed and the oven is going.

Next you may wish to inquire about the furnace, and with the first pitch pipe you sound three shrill notes. This means "Connect me with the furnace and tell me how hot it is." The reply is three short buzzes, telling you that the connection has been made, followed by a pause, then two more buzzes which say, "The furnace is pretty low."

SO YOU blow four blasts from the same pitch pipe, meaning "Connect me with the switch operating the drafts." Televox replies with four buzzes, signifying that the connection has been made, then one short buzz, informing you that the drafts are closed. With one blast from the second pitch pipe you order the

drafts opened. Televox instantly opens them, then gives the long buzz to say that the job is done.

If nothing further requires attention, you blow the third pitch pipe, the lowest in tone of the three, which says "Good bye." Televox hangs up the receiver, and stands ready for the next call.

Each of these astonishing actions, as already explained, is accomplished by a different sound-sensitive relay. When the bell rings, the noise causes the first relay to lift the telephone hook and start the signal buzzer. The high note of the first pipe serves to connect any desired one of a number of relays, each of which has been arranged to control a certain operation. Thus, when the note is sounded twice, it moves a switch that connects relay number two, controlling the electric oven. When sounded three times, it connects relay number three, and so on, according to the number of operations for which the apparatus is designed. Each time a relay is connected, Televox gives a corresponding number of buzzes, indicating that the connection has been made. Moreover, it sounds an additional long or short buzz indicating whether the switch to be operated by the relay is open or closed.

The lower note of the second pitch pipe is the operating note; that is, it causes the connected relay to close or open the switch as may be required; also to report the fact by changing its long buzz to a short one, or vice versa. The deep note of the third pitch pipe simply causes Televox to quit work and ring off.

TO demonstrate that Televox will respond to spoken words as well as musical notes, the inventor has set up in the Westinghouse laboratories at East Pittsburgh, Pa., a mechanism which will open a door to the call of "Open sesame!" The sounds of the voice, however, are too highly complicated for use in general practice. Still, a person with a good ear for music can get response from Televox by whistling or singing in the exact notes to which the relays of the machine are tuned.

Three of the machines already are in actual use in Washington, D. C., replacing

watchmen at reservoirs. By their buzzes they tell the distant caller the height of water as shown by the gage in the reservoir, and also control the flow of water at his bidding.

Even more astonishing, perhaps, though less applicable to general use, is the "Product Integrator," as it is called, developed at the Massachusetts Institute of Technology, at Cambridge, by Dr. Vannevar Bush, Professor of Electric Power Transmission, and his staff of assistants.



Dr. J. Wendley, inventor, points out part of Televox that lifts up the receiver. The relays, amplifiers and filters are shown inside the "mechanical man."

Dr. Bush describes it as "an adding machine carried to an extreme in its design." For whereas the ordinary adding and calculating machines are limited to handling definite numbers, or constants, the new invention deals with those indefinite and inconstant quantities known as variables. These are quantities whose changing values depend on other variable quantities.

For example, as you move the base of a ladder away from a wall the distance to the wall changes. So does the distance between the top of the ladder and the ground. Both distances are variables. Each depends upon the other, and their relation may be expressed by a formula or equation.

In advanced electrical work, as in other sciences, experts constantly face the problem of combining many variables into a single sum or formula. This is known as integration, and the sum of the variables is called the integral. The problem might be compared to computing variations in the rise or fall of a large river by adding up the changing conditions in each of its small tributaries from moment to moment, which in turn would be related to such other variables as rainfall, the condition and slope of the land, and so on. Sometimes the problem is so complex that it will take an engineer from a month to a year to work it out. Sometimes it is beyond solution by mathematical formulas.



Explaining demonstration apparatus by which buttons sound tuning forks into the telephone, the various notes of which make Televox do his work.

Curiously enough, the mechanical brain of the Integrator, which answers such problems in a few minutes, is little more than an electric meter, much like the meter in your home. It performs its thinking processes and reaches its solution by running as a motor, translating the problem into terms of electric power and expressing the answer likewise. This is how it works:

First, the mathematician plots the equations expressing different sets of variables as curves or graphs on a sheet of paper. These sheets are passed slowly under pointers of the machine. Operators along the length of the machine keep the pointers on the curves. As the pointers move back and forth, following the lines, they vary proportionately the amount of power flowing through the machine. Thus the total number of revolutions the meter makes during the operation represents the sum or integral which is the answer desired.

THIS sum, of course, is itself a variable quantity. Instead of expressing the result by hands on a dial, as does your house meter, the Integrator meter controls a motor which moves a pencil over another moving sheet of paper. The line traced is a curve expressing the answer.

By another operation, similar to the first, the machine can integrate the result a second time. Thus, since many electrical equations require but two integrations, they can be handled directly on the machine. The inventor declares it can solve virtually any second order differential equation, a type of problem with which engineers constantly have to deal. Moreover, by answering problems beyond present human mastery, he adds, it "opens the doors to important fields of research hitherto inaccessible."

Marvelous as are the Televox and the Integrator, it is well to remember that they still are far short of being human in one vital respect. They cannot do creative thinking, nor make decisions. Like the calculating machine and the automatic telephone exchange, their great value lies in saving time, labor, and drudgery, and so opening new opportunities for creative effort. In this capacity they are priceless as faithful servants of mankind.



Dr. Vannevar Bush adjusting his apparatus that in eight minutes solves problems that take mathematicians weeks.

Success or Failure— It's up to You!

Five Systems by Which You Can Make Yourself More Efficient

As told to

KENNETH WILCOX PAYNE

By HARRY A. OVERSTREET

TWO young men were fired from the same office a few weeks ago. One, whom I'll call Walter Brandt, promptly found himself a better place. The other, Joe Raymond, is still out of work. These two chaps apparently are very nearly equal in brains, experience, energy and initiative.

Why is it, then, that Brandt is continuing to climb the hill of success while Joe Raymond has stalled part way up? That is a question such as comes to all of us at one time or another. We see the Walter Brandts succeeding brilliantly; we see the Joe Raymonds apparently struggling just as hard but barely getting along. And there is no real difference between the two types except in the vague, indefinable qualities of "temperament" and "personality." Heretofore most of us have assumed that these mysterious keys to success are inherited, that one man born with them goes far, while another lacking them from birth fails.

THAT hopeless assumption is now challenged by the new psychology called behaviorism, whose exponents observe facts in the laboratory rather than weave philosophical theories in the library. By this method we have taken the magic and mystery out of such things as personality. We have discovered that a man's personality is only the sum total of his habits of action. We have discovered that his habits of emotional action are much more important for success than his thinking habits; and finally we have discovered that such emotional habits are not born in us but have been manufactured for us by our parents, our early training and our environment.

So, to ascertain the reasons for Walter Brandt's success and Joe Raymond's failure, all we have to do is study their habitual actions—their emotional behavior. By going back to their childhood we can learn how these habits were formed



HARRY A. OVERSTREET

weeks' notice, went coolly back to his desk, put in some phone calls and wrote to several friends. To his associates in the office, he remarked cheerfully:

"Say, what do you think? The old man's just given me the air."

He let it go at that. No whining or recriminations. For ten days he kept calling on men he knew. He started his third week at a new desk. Walter had a system of quick-acting, fact-facing habits.

Joe went back to his desk in suppressed wrath. He planned elaborate schemes to get even with the boss. He sat down and made marks on his blotter. He let it be known that he'd resigned, after telling the old man where to head in.

HE WHINED about it all to his wife that night. For two weeks thereafter Joe stalked. In the spirit of a martyr he worked overtime getting everything ready for his successor. He did everything he could think of—except hunt a new job. He persuaded himself that he was a courageous sacrifice to manifold responsibilities.

But Joe Raymond was only fooling himself, he was giving one set of reasons for a quite

and find a practical way of helping them change hampering habits. Let's see then what Walter and Joe actually actually, did on the day that they were fired.

Walter, after getting his two

unrelated set of habits—habits learned as a child, habits we can wish onto our own children or spare them if we choose.

Joe was afraid to admit he'd been fired. He was afraid to ask for a new job. He was afraid to face the reality of his situation. Walter Brandt had been blessed by training with the fact-facing, quick-acting



Drawings
by Leonard Fisher

A boy will grow up to be a failure unless his habit of seeking pampering, which the mother fosters, is corrected.



Intelligent? Yes, but dreaming of what he might do and can't do, and neglecting the work that he can do and should do.

habit systems. Joe had been cursed with fact-dodging, dawdling habit systems.

Thus, by analysing their actions in a crisis, we see that these two men—approximately equal in general ability—are decidedly different in their emotional personalities. This difference in personality is plainly the reason why one is earning a good salary and the other is out of a job. And their personalities are not the results of vague, inherited qualities, but of distinct, learned habits of action.

NOW how were these habits formed? Just what *are* habits, anyhow?

Habits are formed by associating certain stimuli with certain responses. When your wife puts a nursing bottle in the baby's mouth, it begins to suck. That's an unlearned response to a simple stimulus. When the whistle blows you go out to lunch. That's a complex set of responses to what we call a "conditioned" stimulus. The stimulus was a shrill sound that would have aroused only fear in the baby. But you have learned, by previous association of such sounds with certain conditions, that the whistle means the lunch hour.

Now recent experiments in psychological laboratories have shown us roughly which responses are unlearned or inherent in human nature, and which are

learned or "conditioned." Dr. John B. Watson, at Johns Hopkins University and elsewhere, put young babies through scientific tests of all sorts—with lights and animals and noises and recording

Why We Are What We Are

WHAT makes one man successful, another a mediocrity and a third a failure? Why is it that some achieve outstanding leadership? What holds back their neighbors, apparently as good men, as industrious and as healthy? These questions are answered here by Professor Harry A. Overstreet, head of the Department of Philosophy at the College of the City of New York and author of *Influencing Human Behavior*.

apparatus and as a result he decided that our original unconditioned responses are relatively few and simple.

The new infant squirms, coos, cries and withdraws from pain. It can hang by one hand, it can suckle and sneeze, it is afraid only of a loud noise or of falling. These are approximately the only instincts we had at birth.

But you and I are full of abilities and full of fears. Where did they come from? We weren't born with any of them. Yet we're afraid of losing our jobs, afraid of standing on high precipices, afraid of snakes. Is the baby afraid of snakes?

Not a bit of it. Babies love to play with snakes. But a little later in life the baby that has no fear

All he had to do was to show a rabbit to a baby and at the same time strike a steel bar with a hammer. To cringe at an unpleasant noise is one of the baby's unlearned responses. Seeing the rabbit simultaneously with this unpleasant experience, the baby howls and tries to escape. Later the sight of the rabbit alone will make it cringe.

The ringing of a bell means nothing to my dog. But if I ring a bell every time I give him a bone, he will soon come to associate the artificial stimulus (bell ringing) with the natural stimulus (a bone). Finally, when I ring the bell, he comes running to me. He's learned a new habit.

That same sound of a ringing bell may set a sailor to watching for a buoy-marked reef; it may start the child in school to putting his books away; it may send you running to the window to look for the fire.

THESE are all learned or habitual responses to a stimulus which would have caused only one thing in the child, that is, fear response. All our habits, helpful and harmful, were formed in this same way. And countless times a day we unwittingly begin to teach good and bad habits to our own children by a similar association of natural responses to unnatural stimuli.

At first your baby cries only when it has good cause in some discomfort. Then mother fondles it. Soon the association is formed between crying and being cuddled. A little later you have a spoiled baby, who turns into a spoiled adult.

This brings us down to the genesis of Joe Raymond's trouble, which, to a greater or less degree, many of us share. Joe was an only son and his mother adored him. She made a great to-do over every bump or scratch. It soon became part of his acquired nature to seek cuddling as escape from trivial discomforts.

Joe's early life was complicated because his mother made all his decisions for him. He never got the habit of making up his mind for himself. To gratify her own vanity, Joe's mother used to boast about her young hopeful while he was present. Naturally Joe acquired the habit of thinking about himself as a very superior person.

BUT now that he is out in the business world there is nobody to boast about Joe and bosses won't coddle him.

Now part of that human raw material at the basis of Joe's make-up is the impulse of self-defense. At the least threat to our pride we fly to arms to protect it. When Joe found that the business world treated him merely as another cog in the machine instead of as a genius, he began to bolster up his self-esteem by withdrawing still more frequently into his childish world of day-dreams.

A good many of us may find similar habits in ourselves. We bolster up our self-esteem by projecting our faults into others, just as Joe attributes the loss of his job to his wife's insistence on going to the movies when he should have been working nights on his books. We all of us escape disagreeable realities by imagining ourselves. (Continued on page 138)



Intelligent? Yes, and his intelligence is effective because of good bodily, social and mental habits. Instead of dreaming he tackles the job in front of him, faces facts, thinks straight and acts

of a snake may show terror of so harmless a thing as a white rabbit. The baby has learned that particular fear from some chance association. Watson found out how to make any child afraid of a rabbit, afraid of a fur coat—afraid of a stick of candy!



Battleships on Wheels

No feat of the American Navy in the great war was more spectacular than that of the big railway guns. Largest in France, they had a range of twenty-five miles and proved decisive at crucial moments. On these pages Admiral Plunkett, who commanded them, and Mr. Johnson, who as a war correspondent observed them in action, begin the dramatic story of these tremendous weapons that helped hasten the end of the war.

OUR Navy's most spectacular deed in the world's greatest war was not on sea, but on land, and at the critical place and time to hasten the war's end. American battleships on wheels cut the main German line of supply and retreat in France by hurling shells weighing a ton twenty-three miles to blast away their vital railroads at high tide of the greatest battle in world history.

Web-footed American guns shot those shells from fourteen-inch American naval guns on special steel railroad mounts made in America. They were the most powerful guns on the Western Front, bar none, not even the German Berthas, which had far less force though longer range. Every gub knows the Berthas left the front just before the American naval guns approached it and says: "They knew we were coming."

SO WE were, the snouts of our long blue-gray guns decorated with wreaths by French crowds cheering beside the tracks over which at six miles an hour we crawled majestically, like a fat old lady crossing a street—and, like her, hoping nothing would happen. No French railroad had ever before borne such a weight, and everyone but ourselves believed we would spread tracks, crash through bridges or get stuck in tunnels. Even we held our breath sometimes, but while we had adventures aplenty, none of those things happened.

We came through and did our job. First our battleships on wheels "sank" the city of Laon, and blew up a movie theater full of Germans. Then they cruised to Verdun and cut the railroad from Sedan to Metz that the

Germans called their "life artery." For nearly a week before the first American dough boy saw that railroad, the Navy was hawking it up faster than the Germans could mend it. When the war ended two of our big guns were in position to fire into Germany.

AND more than half the time, we couldn't see what we were shooting at, even through an aviator's eyes. We had almost no airplane observation in the last big battle of the Meuse-Argonne, and had to shoot "off the map," depending on the accuracy of our mathematical calculations and the straight shooting of our guns. Our shells went up 85,000 feet before they started to come down, but of the 788 we fired in France, fully two thirds had material effect and every one had moral effect. The Germans tried to shell us out, killed and wounded a few, but we never budged.

Pretty good for a bunch of Yankee tanks up from the sea, lugging about France, intruding on the Government's railroads and the American Army's war. We thought sometimes we would have to beat the French and the A. E. F. before we could beat the Germans. We firmly believed in ourselves and our idea and our guns, but we simply had to show other people of little faith. For a while it seemed the idea was too big for about anybody to get except General Pershing. He was always our friend, but some of the men he had working for him were slow catching on.

Perhaps it didn't help us that we were about the weirdest looking military outfit in France. On the outside, gobs and officers wore Marine uniforms of greenish gray, Army tin hats, gas masks and mess-kits, but underneath they were still sailors and wore their blue blouses and sweaters. The railroad cars they lived



Pershing, who, when the British feared to risk invading U. S. Navy's big guns in France, cabled, "Come on."



A naval gun battery complete with equipment for transporting and firing

Here, After Ten Years, Is Revealed the Real Story of the Huge Guns That Went Ashore and Beat "Big Bertha" at Her Own Game

By REAR ADMIRAL CHARLES P. PLUNKETT, U. S. N.

In Collaboration with THOMAS M. JOHNSON

in were painted white inside and had ship's bells. When I "came aboard" they wanted to pipe me over the side, but were afraid some doughboy would take the boys' whistle for a gas alarm.

They were chosen from twenty thousand applicants—a group of five hundred young Americans, energetic and resourceful, only twenty-five of whom had been in the old Navy before the war. The officers were the same kind, many volunteers from reserve.

After the war, our knowledge gained in France helped provide our country with the new sixteen-inch coast defense rifle, the most powerful such gun in the world and so mobile that one traveled recently by rail from the Atlantic to the Pacific.

My principal remembrance is of my pride at commanding so fine a lot of men on a mission so unique.

It really started November 12, 1917, when I was "Company Officer" of the Navy in charge of target practice, especially with the biggest guns we had. Then Rear Admiral Ralph Earle, Chief of the Navy Bureau of Ordnance, got the idea that recalled in the best adventure of my life and one of the biggest achievements in the Navy's history.

ONLY the insiders knew it—the censorship took care of that—but then, four months and more before the first "Bertha" shell traveled 88.8 miles to hit Paris, the Germans had guns throwing shells forty miles, nearly twice the maximum range of any big gun ever before known.

Those guns were fired from near Cambrai, and their shells struck St. Omer and Doullens, important railroad junctions behind the British front. That nearly drove Allied gunners wild, for they had been trying ever since April 28, 1915, to stop the bombardment of Dunkirk by German twelve-inch guns firing twenty-eight miles, and now here was a still longer-ranged gun. What next?

In November, 1917, all knew there would be a great German drive in the spring to end the war, before the Amer-

icans could get fully into it. Suppose the advancing German armies had many such guns! They would reach Calais and Boulogne. They might even throw shells across the English Channel into Dover. To be forced to abandon the Channel ports would be a catastrophe for the Allied cause.

THE German forerunner of the Bertha was a 280-millimeter forty-two-caliber gun, about eleven inches, throwing a shell of 1038 pounds as far as 51,818 yards with muzzle velocity of 2025 feet a second. Admiral Earle decided to pit against it our fourteen-inch fifty-caliber naval gun, the main weapon on our most powerful battleships. Its 1400-pound shell could be thrown 48,000 yards, but at an initial muzzle velocity of 2400 feet a second, and we believed it would strike a harder blow than the German shell.

Our fourteen-inch gun could deal a harder blow at longer range than anything the Allies could bring to bear. The best the British had on land was a twenty-inch gun. The French had a ten-inch gun of 36,000 yards and a twelve-inch howitzer of 16,500 yards. Their secret 500-millimeter, 80.5-inch howitzer was not of long range. The Italian eleven-inch gun threw a heavier projectile than ours, but neither so far nor so hard.

By the time our guns reached France the German drive would be on. We must adapt our guns, made to be used on battleships, to traveling on railways; we must devise rolling repair shops, machine shops, ammunition cars, cranes, wireless outfits,—we must make battleships on wheels.

Admiral Earle's idea sparked at once. The Navy's convoy work, antisubmarine campaign, and North Sea mine barrage were splendid services of the greatest value in winning the war, but they did not appeal to popular imagination,



Plunkett, who, when Pershing said, "Come," went, and with the U. S. Navy's mobile guns out-Germanned Germany

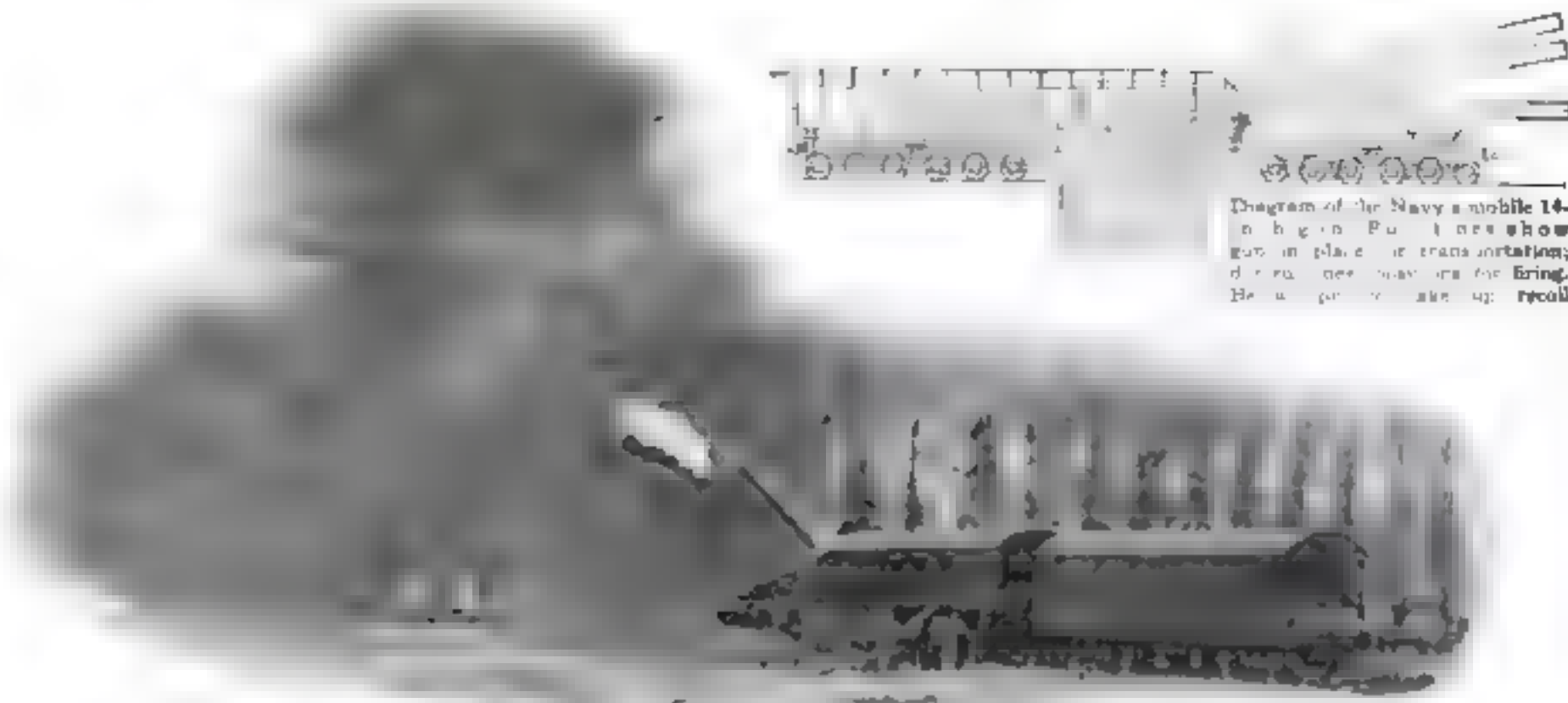


Diagram of the Navy's mobile 14-inch gun. Pull lines show gun in place of transportation; dotted lines show its firing. Heavy gear is set up; recoil

Firing one of the Navy's 14 inch rifles in the *Maine* Argonne, the biggest battle in which Americans fought. The weapons hurled 782 1400 pound shells before the Armistice and proved most effective in destroying railways and troop depots.

and the Navy had never had its just share of credit for them. Here was something that thrilled the sailor man.

On November 26, 1917, the Department approved Admiral Earle's plan and only two weeks later the drafting room force at the Naval Gun Factory under Commander Harvey Delano, the most overworked lot of men I ever saw, had produced its first report. Battleship turret mount designers and men experienced in bridge and locomotive work gathered all available data on the French railways, and called upon Admiral Sims, commanding our forces in European waters, for other data. By January 25, 1918, 136 standard drawings and eleven sketches were ready for submission to bidders.

The gun car had to be strong enough to carry the rifle, fifty-eight and a third feet long and weighing ninety tons, and to stand the shock of its firing at an angle of elevation from zero to forty three degrees, with a resulting transom pressure of 1,000,000 pounds and horizontal and vertical reactions of about 700,000 pounds each. It had to be light enough to get over railroads and bridges, and small enough to get through tunnels. That gun car was some job, but it was done, thanks to Commander Delano, Capt. A. L. Willard, and Mr. George A. Chadwick, and a shoal of helpers.

THE gun car had as backbone two main girders seventy-two feet long, weighing 135,830 pounds. They were tied together and cross-bracketed at each end, where were U-shaped housings in which were placed cast steel H-beams, each carrying a center-pin socket. These received the center pins on the two twelve-wheel car trucks placed at each end. Structural steel girder beams formed the frames of the trucks and carried the

load to the axles, which turned in nine-by-twelve-inch boxes with coil and equalizing springs to distribute the load.

Every "expert," Allied or American, who saw the gun car afterward, it seemed to me, told us there was too much axle-load. The whole car and gun weighed 535,000 pounds, and a New York Central locomotive and tender, class 1300, weighed 518,240 pounds. Our battleships on wheels would collapse, we were told. But we knew they wouldn't, and they didn't.

ANOTHER big problem was placing the gun so that the girders would take up the firing load and recoil. The gun was placed in the well between the two girders, which were made especially heavy at this point. The deck lugs of the gun were fastened directly to this heavy girder web by steel bolts. The slide was installed between the lugs, and the elevating gear—a worm in an oscillating bearing operated by hand through a train of gears—was placed beneath and

fastened to girder flanges and crosspieces.

That was all right for shooting at angles up to fifteen degrees, which would give 23,000 yards range. But we should need our maximum range of 48,000 yards, requiring elevation of forty three degrees.

An important part of the theory of long-distance shelling is that the higher the elevation of the gun, the greater the range. The Germans first put the theory into practice with the Leugenboom guns that shelled Dunkirk and the St. Omer-Boullens guns that reached forty miles, then a record. In discovering how to do that, they also discovered how to develop the Berthas that on March 23, 1918, threw a shell seventy-two miles into Paris. Our shell was fourteen-inch, seven times as heavy and with greater bursting charge, with twice the muzzle energy. We had to contrive a mount that would enable us to elevate the gun enough to get this big shell far into the rarefied upper atmosphere and give maximum range.

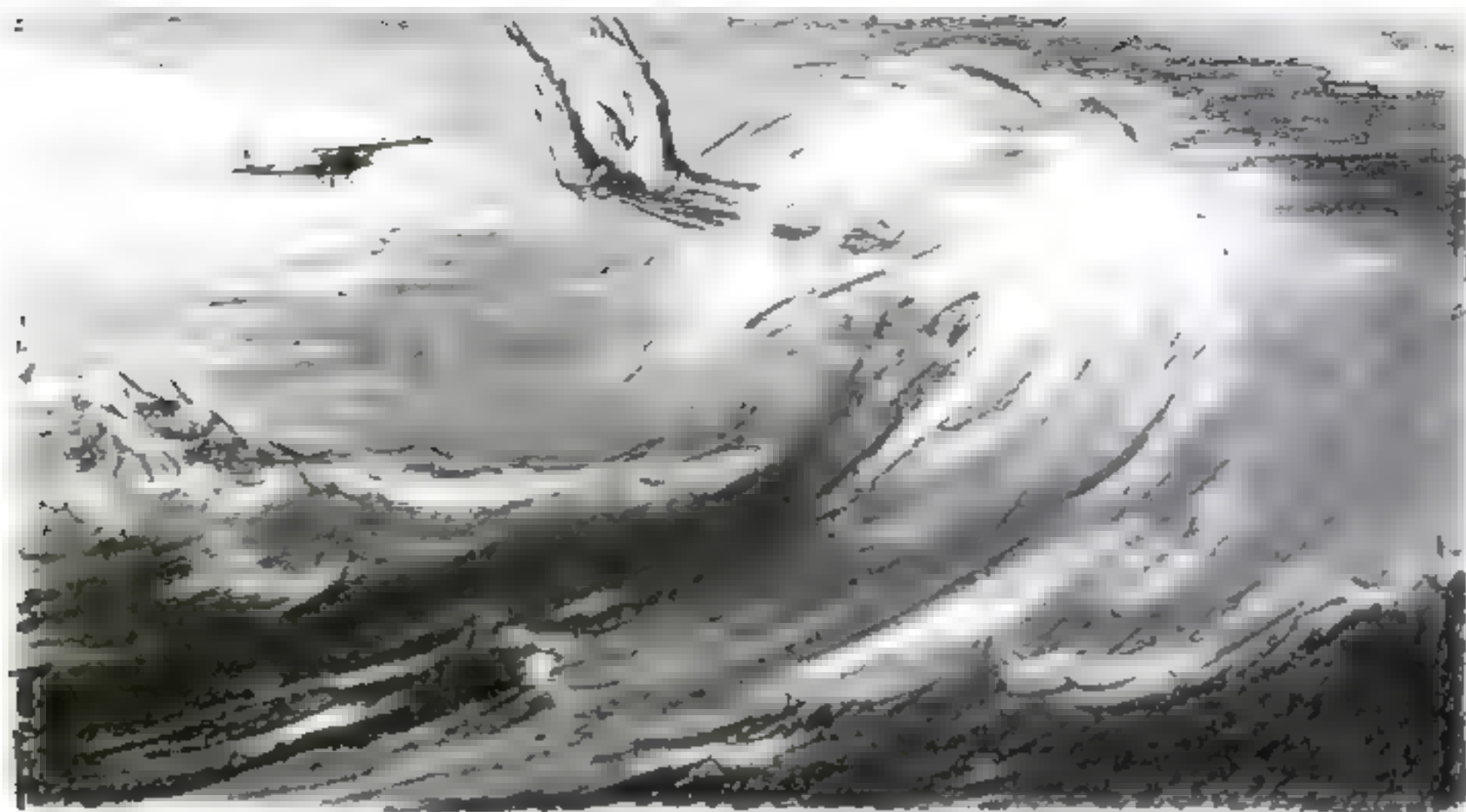
The main problem was that of the recoil mechanism. Of course, the higher the muzzle went into the air, the lower the recoil mechanism was depressed—like a seesaw. We fixed that by digging a hole between the rails at the spot where the gun was to fire. Then a crane car placed in the pit a foundation of timber work backing and structural steel girders, and a heavy steel casting called the transom bedplate. That took about twenty hours.

NOW, each gun car had fastened to the girder webs and flanges a transom bedplate casting similar to that in the foundation. When it was directly over the foundation casting, 100-ton ball-bearing jacks were placed under the corners of the H-beams at each end of the gun-car girders, and the entire

(Continued on page 128)



In the field, Franklin D. Roosevelt, then Assistant Secretary of the Navy, and Rear Admiral Plunkett, in charge of the Navy's gun campaign against the Germans, inspecting one of the guns at Montoire, France, in 1918.



Why Don't We Fly?

By CAPTAIN FERDINAND TUOHY

BY A queer turn of the wheel 1927 will be remembered as the year that yielded the most superb individual feat in aerial annals—Lindbergh's flight—and as the year in which we first passed for a serious examination of our vaunted "conquest of the air."

Of course, for years previously, and at the expense of being greeted as croakers and pessimists, a small body of reasoning publicists and others had been insisting that our grandiose aerial age was a myth and likely to remain so as long as the airplane as at present conceived held the field. However, the international press as a whole continued to write airily about the air as if it were everybody's element.

The truth about aviation lies between those extremes, and if we are ever to get a fair assessment of this air tangle, generalizations must be abandoned and the matter gone into systematically.

The first essential is to tackle that hoary old stand-by of the special pleader, "The airplane is still in its infancy." Frankly and brutally, it is not—at least if judged beside kindred inventions. Stephenson piloted his first passenger train in the north of England in the early 1830's, and less than thirty years later the main railroad tracks that exist to this day in England were being laid. Take the automobile. The Marquis de Dion drove the first "horseless carriage" down the Champs Elysées in 1891, and development in construction ceased, to all practi-

CAPTAIN TUOHY, English war veteran and distinguished international journalist, speaks here from an unusual point of view, a perspective obtaining in both England and America. Yet that aviation is striving to overcome the situation he cites is shown by the interest of airplane builders in such efforts as the Daniel Guggenheim Safe-Aircraft Competition.

cal intents and purposes save for detail and embellishment about 1911.

In short, the airplane's two competitive locomotion inventions were rapidly developed to a point of popular usage where they have remained more or less and save for mass production, ever since.

BUT what of the airplane? It cannot be rated at less than thirty years of age. Of the two separate inventions which compose it, the internal combustion engine was invented by de Dion thirty-six years ago, while the framework-cum-fuselage dates back to 1897, when the German Lienthal, a contemporary of Langley and Ader, glided to his death in a heavier-than-air machine of the general pattern that was later, in 1902, fitted with a motor by the Wrights and flown at Kitty Hawk, North Carolina.

Yet the "age" of the airplane can scarcely be fixed thus arbitrarily, since

during its adolescence there befell the amazing scientific interlude of the war, in the course of which both construction and flying of aircraft were so intensified that the late Lord Northcliffe, flying's first patron, said "the science of flight was advanced at least fifty years beyond the point it would have reached normally in our time had there been no war."

Fifty plus thirty. Technically we are entitled to contemplate the airplane as an old dodderer of eighty. But let us not be harsh. Let us call it fifty.

Proceeding, we stumble against this considerable circumstance: that the airplane, unlike kindred inventions, arrived in dawning completion. The biplane that Wilbur Wright showed the world in 1908 at Le Mans was able to keep the air for several hours, to tackle cross winds, and to fly, if need be, at the safe landing pace of thirty-five miles an hour. Primitive, yes, but within a year other brains had scrapped this and that—the starting rail, the funny fuselage with its enthroned joy stick, the box-kite appearance, and so on—and turned out biplanes and monoplanes not vastly dissimilar to those in use today.

AND with those machines transcending feats were soon accomplished by Paulhan, Latham and Curtiss, Beachey, Bleriot, the Farman, Grahame-White, Garros, Rolls, Moisant, Delagrangé, Nieuport, Leblen, Hawker and Chavez (who crossed the Alps to his death), finally by Vedrines, who landed on a Paris roof, and



In war Mars smiles approval on the exploits of men risking and often losing lives in airplanes, but in peace Neptune, supported by all the elements, thrusts forth forbidding hands to men and their mechanical birds who try to span the oceans, saying, "Not yet. You do not know enough."

Airplanes Fail as Practical Carriers and Demand Revolutionary Improvements, Says the Writer of This Illuminating Article

by Pegoud, who laughed at Isaac Newton by jumping the loop.

That was the airplane's real period of infancy—those six breathless years, 1908-14, that preceded the war. And as an indication of how far the infant progressed in them, perhaps it will surprise many to learn again that thirteen years ago, in June, 1914, the German Stoeffler succeeded in remaining aloft twenty-four hours, or twelve times Wright's record of five and a half years before!

AND yet in the last thirteen years we have only slightly more than doubled Stoeffler's record.

Two years, I imagine, the air historian of the future will choose for his elucidation of the early years of human flight—1909 and 1927, the first, the year the world grasped at a new and wonderful celestial circumstance, the second, the year it found the heavens had eluded it—at least for the time.

Thus armed with some degree of perspective, we may now switch directly to the facts of the day.

The airplane is a colossal success in war.

Reserved at first for reconnaissance in the World War, heavier-than-air craft soon came vitally to affect the conduct and progress of military operations in half a dozen spheres. But the brilliant aerial termination of the war with thousands of machines all day and all night fulfilling their diverse missions, requires scant recalling here, rather should we be occupied reviewing the likely expansion of their

activities in the future—especially long-distance raids, thanks to machines now able to cover 2000 or 3000 miles without stop (the real significance of recent happenings) and an assured all-round increased use of airplanes flying from parent carriers.

However—and it is the biggest "however" one can imagine—war-time construction (and flying) was carried out with a minimum regard for safety measures that would encroach upon war efficiency, upon the ability to rise steeply, maintain high speed, turn swiftly, roll, spin, loop and zoom, to avoid an enemy or to gain better contact with him. How many of the legion who "failed to return" fell victims to their own machines, nobody ever knew in that inferno.

In short the airplane made grandly good in war while enjoying a latitude roundly and rightly denied it in peace time.

LET us next turn to what has supervened since the Armistice. The entire war organization, thousands of pilots and all, would, we were told, be forthwith transferred to peace-time service. Soon we should all be flying. In actual fact, during the last nine years the airplane has steadily gained as a useful accessory in special situations and an occasional boon in addition to postal mail flights (chiefly in the United States) and the more or less regular functioning in Europe of eighty-one air lines whose entire fleets may daily take aloft perhaps the equiv-

alent of a train load of passengers.

In fairness to the airplane we must remember that it has been used with greater or less success for the carrying of mail for exploration, for mapping and surveying, for hunting and fishing, for the destruction of insect pests, and for other similar and undeniably useful purposes.

MOST praiseworthy and promising but rather far behind what was promised us! I am well aware that interested parties have statistics all ready showing that it is safer to fly than to take tea in one's own den; yet statistics also show that the only real air line in existence, Paris-London, carried but 8000 passengers in its peak year, 1926, and that accidents or forced landings were frequent. And the general feeling of these aerial travelers is of doing a thoroughly risky but fearfully exciting thing, a sentiment wholly absent when one gets into a train or automobile. One regular Paris-London air passenger that I knew well, Rase, a Paris maître d'hôtel used to say "One day I shall be in for it I know." And he was right—killed in Kent. On a par with this form of aerial precaution may be cited the airman's own dictum that "if you stick at it long enough, you're bound to get killed."

The chief Paris-London perils are fog and landings forced by engine trouble. There have also been head-on collisions, "shipwrecks" in mid-channel, with a dozen passengers. (Continued on page 139)

Plants Put to Bed For Their Health

Though Its Working Day Can Be Stretched by Artificial Light Even a Vegetable Needs Sleep

By EDWIN KITCHUM



A cabbage growing far more luxuriantly than others because it has 17 hours light every day

BLUE light cast a weird shade over our faces, as we stood in the "spectral greenhouse." Beyond, broad beams of yellow and orange tinted sunshine bathed boxes of growing plants in an unnatural radiance.

Growing plants under colored lights to find out how they behave—that is but one of the strange experiments you can watch daily at the Boyce Thompson Institute for Plant Research, in Yonkers, N. Y.

Here plant growers make their own weather and germinate seeds at freezing temperatures—oddly enough, in electrically "heated" ovens. They scrub coal gas clean and feed it to plants. They have shown that plants, unlike animals, get along splendidly without the ultra-violet rays of sunshine.

WHY plants and seeds grow—how to raise and multiply them—these are the questions that experts at the institute are spending millions to answer. Nowhere else in the world is the duplicate of their "constant light room," where it has been proved that all plants must have sleep, and that many need the full eight hours human beings require. In this room with twenty-five 1000-watt lamps are carts of potted plants, with numbers

indicating how many hours they must sleep.

These plants never see sunlight. At specified hours they are "put to bed" in an adjoining dark room. Tomato plants become spindly and weak when their "working day" in the light is stretched to nineteen or twenty hours. Maryland tobacco and ragweed require a goodly period of darkness in order to flower.



The only constant light room for plants in the world. Here plants are tested in the glare of twenty-five 1000-watt electric lights to see what length of "working day" is best for them. Later, in a dark room, they are "put to bed."

Left: Six pots of barley forty-one days old. The two pots at extreme left were grown in ordinary greenhouse conditions, those at the right in same conditions but with an additional six hours of light, those in the middle, in same conditions as those at right but with aid of carbon dioxide gas.



Dr. William Crocker, Boyce Thompson Institute chief, tours greenhouses to see how his plant pets are faring

Turnips, salvia and cosmos occupied one greenhouse I visited with Dr. P. W. Zimmerman, one of the experts. They seemed rather undersized in the blue room, beneath the yellow panels' cheerful light they were vigorous and bushy, while under the orange they were tallest of all but spindling.

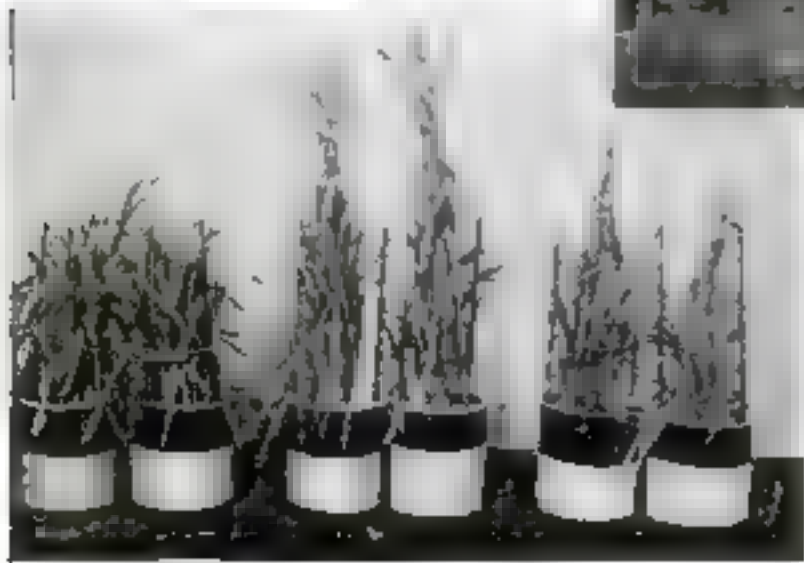
Under the microscope, samples of stems showed that the blue and violet parts of sunlight are both necessary to plants. Without the blue, the plant is likely to seed or fruit imperfectly.

DR. ZIMMERMAN and his assistants are seeking to reduce the cost of seventy-five-cent-a-quart blueberries—the choice, oversize kind. And to the conservation plea, "Don't cut wild holly for Christmas greens," they respond "We can show you how to grow little holly trees in pots, loaded with berries like a grown-up tree."

In the laboratory of Dr. William Crocker, director of the institute, I saw seeds mashed up and agitated by a mechanical shaker in an odd-shaped vessel with a little hydrogen peroxide. The escaping bubbles collected and measured, indicated the seeds' vitality.

Dr. F. E. Denny has sprouted potatoes in two or three weeks instead of two or three months by treating them with a chemical called ethylene chlorhydrin—a close relative of the ethylene gas used to hasten fruit ripening.

COAL gas (rich in carbon dioxide) from the institute's boilers is scrubbed clean and released to the greenhouses for the plants' use. Some plants mature far ahead of their normal time when so fed. Open-air plants also are fed carbon dioxide through perforated tubes, while duplicates in a neighboring plot get none, for comparison. The heavier gas sinks so that the plants can breathe it. Many grow markedly faster. This plan has already been tried with profit in the German sugar-beet fields.



How the World Will End

Astronomy Predicts Annihilating Explosion Such As That Which Hurlled the Asteroids into Space

By RICHARD ALDEN SWALLOW

THE world will end in a gigantic explosion! As it grows old great cracks will appear in the Earth's surface, like lines on an old man's

face. These cracks will widen into vast abysses, until at last the entire globe will be rent asunder. A colossal blast, a momentary flash in the starry heavens, and our planet will be snuffed out forever scattered into countless fragments flying through space.

And the universe will go on as before, unmoved, unaware of the catastrophe that has occurred in the family of the sun.

Ages before this happens the Earth's people will gather on the hilltops to see the old moon go to its death in a solar blast. They will see our satellite torn apart like a bursting bomb. The rise and fall of the tides will cease. Nights will be turned into blackness save for the feeble glimmer of distant stars. Countless generations later, other men will witness the spectacular destruction of the planet Mars, a foretaste of the fate awaiting our own planet.

For the sun and its entire family of worlds are doomed in the end to be blown to fragments.

SUCH is the startling theory recently advanced by Dr. Dinamore Alter, head of the Astronomy Department of the University of Kansas. It is based on fifteen years' observation and telescope study of the asteroids—midget planets which have been discovered by the hundreds, flying in regular circular courses about the sun, and which Doctor Alter concludes are fragments of a great planet already exploded. Some are large enough to hold a good-sized city; others are believed to be no larger than a baseball. But all show unmistakable signs, Doctor Alter says, of having come from a shattered world which vanished perhaps a billion years ago; ages before men appeared on Earth.

From their positions and behavior, he adds, it is even possible to place the former location of this lost planet at a point about midway between the orbits

of Mars and Jupiter, or about 170,000,000 miles distant. For this he has found fascinating evidence.

In the first place, the orbits of vir-

which sent them on their journeys. Several other points seem to be the centers through which a number of the smaller fragments pass. Each of these, perhaps, marks a place where a larger fragment exploded in turn.

I doubtlessly hundreds of the midget worlds remain to be discovered. But from the catalogued masses of those already known—about 1,300 in number—Doctor Alter has calculated that the lost planet was larger than Mercury, yet considerably smaller than Mars.

BUT what made it explode?

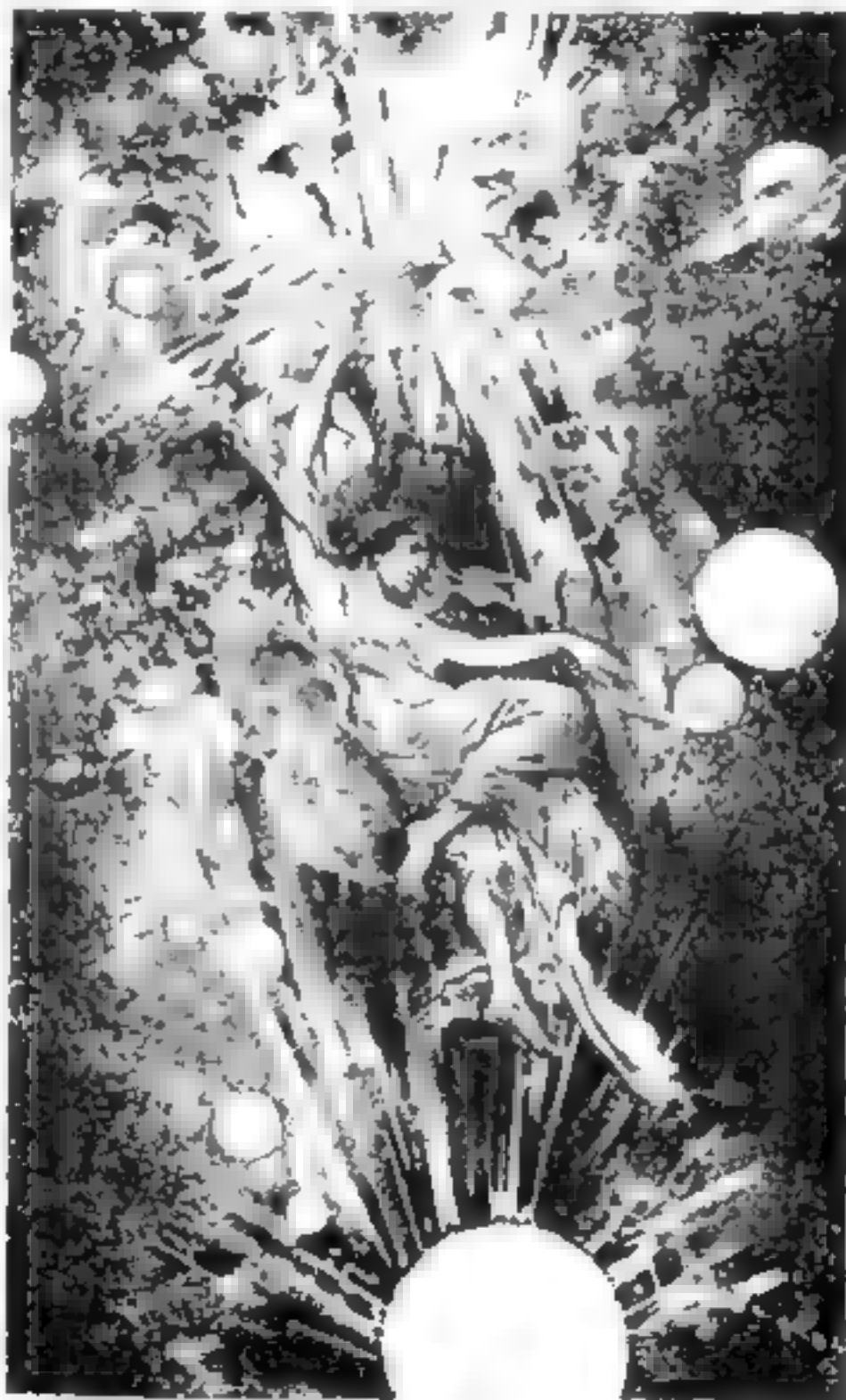
The causes, he explains, were the same as those which eventually will result in annihilating every member of our solar family. As everyone knows, most solid substances expand with heat and shrink as they cool. Once the Earth and the other planets were fiery hot. Cooling through the ages, they gradually shrank. The surface, of course, cooled more rapidly than the interior. Consequently the shrinking crust tightens about the hot inner core. The result is tremendous pressure within which steadily increases as the planet ages.

If the surface rocks were elastic, like a rubber band, they might stretch and so withstand the pressure. Instead, they break apart. As the cooling process continues, the planet's crust develops enormous cracks which open wider and deeper. At last they become so deep that the whole sphere bursts.

STUDY of the asteroids indicates that the vanished planet first burst into four large pieces. These, in

turn, went through the same processes as the parent body and exploded. Perhaps their fragments followed the same course.

"If men had lived on Earth at the time," says Doctor Alter, "they could not have heard the blast. There must be air to convey sound, and there is no air in space. If the explosion was extremely violent, they might have observed a great



Below the symbolical figure of destruction is the sun; above, the exploding planet of Dr. Alter's theory. Other planets shown are, in order, Mercury, Venus, Earth, (Moon), Mars, Jupiter, Saturn, Uranus, and Neptune.

tually all the asteroids thus far discovered lie mostly within a great gap of space between the two planets—a void which, according to astronomical laws, should be occupied by another planet. Moreover, a number of the larger asteroids, in each voyage around the sun, pass through a common point in this space. It is easy to infer that at this point occurred the mighty explosion

flash of light. It is barely possible that portions of the planet were hurled as far as the Earth's path around the sun. A few of the meteorites that flash across our skies may be small asteroids.

"The explosion did not noticeably change the orbits of other planets, nor their relation to each other. The loss of gravitational attraction previously exerted by the planet must have been so slight as to be virtually immeasurable.

"Since the planet was about three times as far from the sun as is the Earth, and received only about one eighth of the amount of heat we receive, it is doubtful if life existed there. But if it did exist, it probably was snuffed out with the catastrophe.

THE annihilation of the moon, Dr. Alter prophesies, will be the next spectacular event in the solar system. Though no older than the Earth, its parent, it has lost its heat much faster because of its smaller size. Even now, he says, great openings in the moon's surface may be seen through the telescope.

The explosion of Mars will come next, preceding the destruction of the Earth because Mars is farther away from the sun and thus receives less heat. The "canals" of Mars, he says, may actually be great cracks in its surface.

As for the Earth, there is little to fear for millions of years.

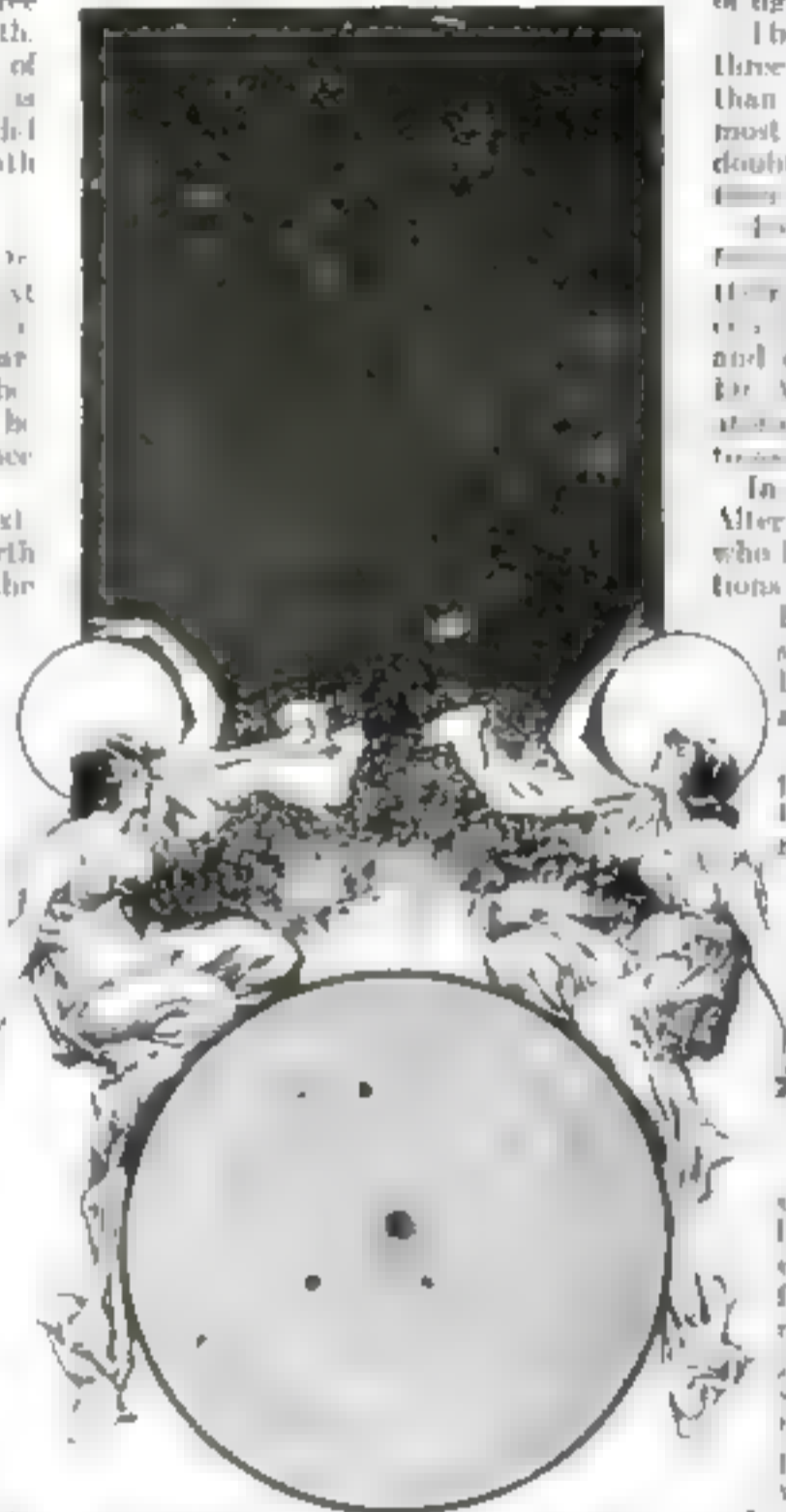
"The surface of our planet is in excellent condition at present," Dr. Alter assures us. "The Earth is extremely hot inside. It will not cool sufficiently for cracking for many ages. I do not consider earthquakes a sign of coming destruction. They are purely local upheavals. Before the planet would break apart, the cracks would have to extend far into the interior. Cracks even a thousand miles deep would not necessarily mean its disruption. When such cracks do appear they will be appalling, no doubt, to people living then, but they will simply be harmless indications of a fate which will visit the sphere a few millions of years farther on."

EVEN the sun is likely to come to the same end, Dr. Alter adds, though its explosion cannot occur for trillions of years. Each second the sun loses 4,000,000 tons of its mass in supplying the heat energy which it shoots off into space. But this amount, vast though it may seem, is so insignificant compared with the size of the sun that in a million years the amount lost would not be noticeable.

In his observations of the strange heavenly fragments on which these amazing predictions are based, Dr. Alter has added much to our knowledge of the asteroids. Until the beginning of the nineteenth century the midget worlds were not known to exist. Ceres, the first to be discovered, was found by the astronomer Kepler in 1801. The largest and brightest, it is the only one that ever has been even faintly visible to the naked eye. It is so tiny that viewing it is like looking at a pin point a mile away.

The diameter of Ceres is 480 miles, less than the distance from New York to

Cleveland, O., and its mass has been estimated at 18000 that of the Earth. Among the other larger asteroids are Pallas, with a diameter of 304 miles, Juno, 120 miles; and Vesta, 240 miles. Because of their small size, their force of gravity is far less than the Earth's. A rifle bullet shot from the surface of Ceres, for instance, would fly off into space never to return, and would itself become a tiny orb revolving around the sun.



Above: Photograph that discovered the asteroid Eros, 15 miles in diameter. The plate, exposed for hours, was moved to keep stars in focus. Eros, moving faster, hence appears as a streak at top instead of a dot. Below: The positions of the planets in 1930-31, when Eros will be within 16,200,000 miles of the Earth.

Eros, only fifteen miles in diameter, comes closer to the Earth than any other known asteroid. In its elliptical orbit its nearest approach is 13,840,000 miles, a little more than half the distance to the planet Venus, yet so far that if we could travel toward it at a speed of 500 miles an hour, it would take three years to get there. Eros made one of its rare visits in 1894, soon after it was discovered, and another in 1901, when astronomers made thousands of observations of it. Its next approach will be in 1930-31, when it will be 16,200,000 miles distant, or about one sixth the distance to the sun. To arrange for a more careful study of the midget at that time, a "reception committee" of

astronomers already has been formed. Through this study, incidentally, they hope to establish more accurate means of measuring distances in space.

Eros is so small, however, that little can be learned of it by direct observations through the telescope. Like other asteroids, it can be studied successfully only by telescopic photographs. Even on a photographic plate, exposed for several hours, it appears merely as a tiny point of light.

The smallest asteroid known is only three miles in diameter. Smaller bodies than that cannot be seen even with the most powerful instruments, though undoubtedly there are many thousands of them.

To search the heavens further for these fascinating little objects, and to trace their paths, the University of Kansas will complete this year a large new telescope and observatory under the direction of Dr. Alter. It will be one of three observatories in the world devoted exclusively to asteroid study.

In advancing his explosion theory, Dr. Alter disagrees with some astronomers, who hold that the midget worlds are portions broken from the surface of planets. He also doubts the suggested possibility that asteroids, once having been a planet, may reform into another one.

"It is difficult to make such a prediction," he says. "I am inclined to believe that these little bodies will remain just tiny separate worlds, maintaining their own orbits about the sun. There is no reason to believe they will change."

IT IS impossible to determine the elements that compose them by analyzing their light with the spectroscope. All it shows is reflected sunlight, and from that we get only the elements of the sun. Variation in light rays from the asteroids, however, gave us some indication of their form. Apparently they are not round, but irregular in shape, with jagged points—a fact that would seem to support the theory that they are torn fragments of an exploded planet. They continue to whirl as did the planet before them.

Naturally the question rises: What will become of all the people on earth if such a catastrophe as the scientist has envisioned occurs?

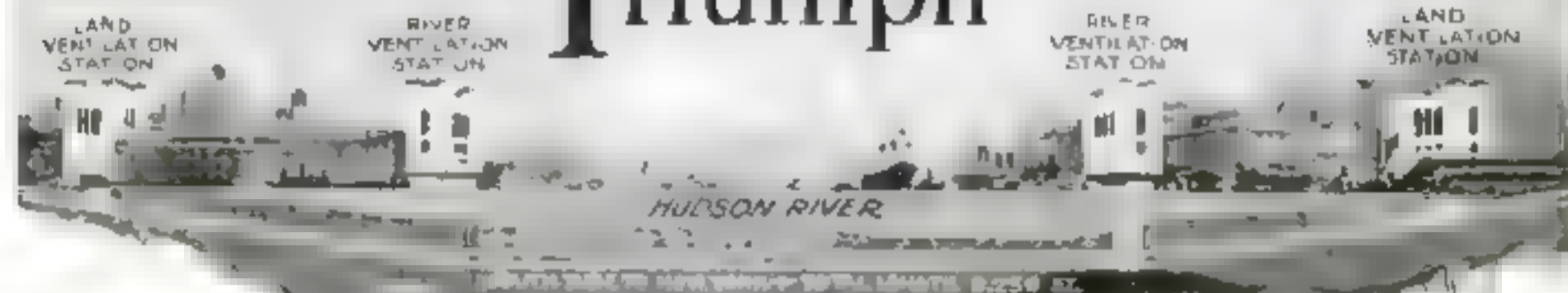
Long before the earth blows up, Dr. Alter predicts, all forms of life, including man, probably will have vanished. But if life at all survives the latter end of the aged Earth, it hardly can survive the final blast. Atmosphere would vanish with the break up, and this would spell the doom of any animal life which might withstand the force of the explosion itself.

Still, it is fascinating to imagine scientists of some far distant day observing Mars in its last agony and wrestling with the problem of saving the cracking Earth and its terror-stricken people from a similar fate. We may even stretch our imaginations a little farther and see engineers devising fantastic machines to which to transport earth dwellers across the abysses of space to some younger and more substantial world.

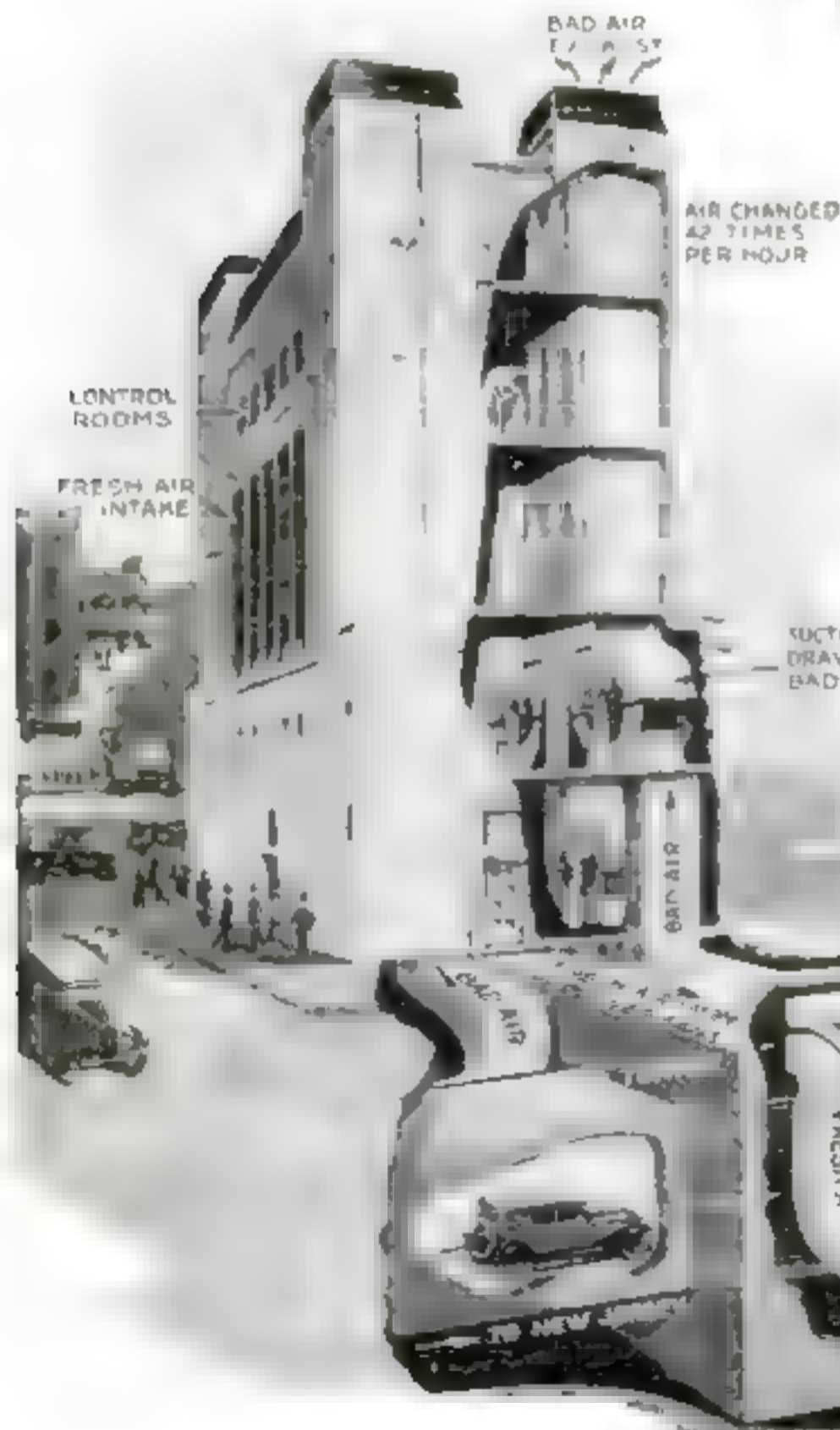
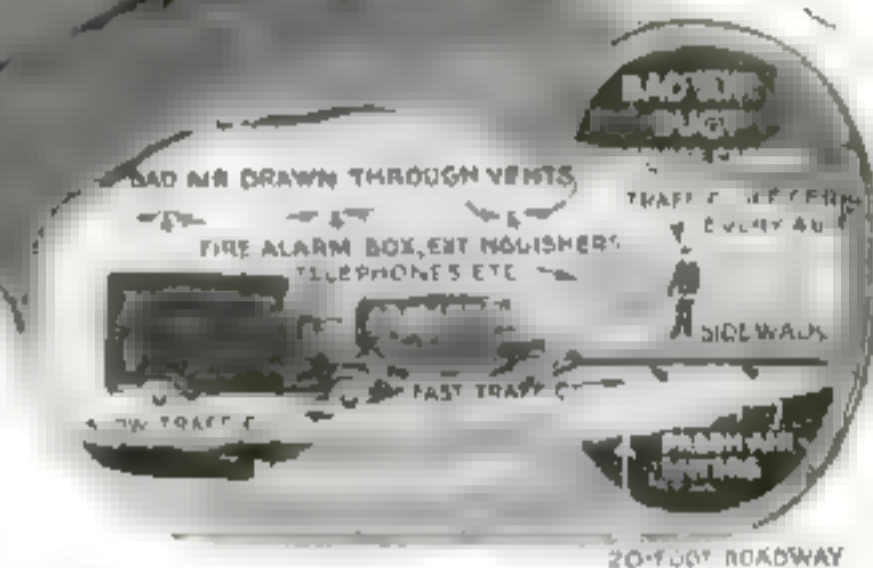
Compressed Air's Greatest Triumph

NEW JERSEY

NEW YORK



Above: General diagram view of \$50,000,000 tunnel's twin tubes at 150 feet below the surface of the Hudson River. The tunnel is 1,500 feet long and 21 feet in diameter.



HERE are pictured details of one of the world's great engineering achievements—the Holland tunnel for vehicle traffic under the Hudson River between New York and New Jersey, recently opened. The construction of the tunnel was a triumph for compressed air, which enabled the diggers to push through chambers of successively greater pressure to enable the men to work at the point of work. Just above is shown the interior of a finished tube and the system that replaces motor exhaust fumes, moving them out of the tunnel with fresh air. On page 40 of this magazine the gas flames are illustrated. The drawings at top left and below show one of the four ventilation buildings.

FRESH AIR ENTERS THROUGH LOUVER WINDOW

100 PLETS OF FRESH AIR SUPPLIED TO TUNNEL EVERY MINUTE

Marvels We Saw in 1927

LEADERS in many fields of invention, research and discovery tell of the year's progress — wonderful structures and machines, conquests of the earth and sky, new victories over disease, promise even more riches, health and comfort in coming months

CIVIL ENGINEERING

GUSTAV LINDENTHAL, D. Eng.

Noted Engineer and Bridge Designer



ADVANCES in civil engineering during 1927 are exemplified in many notable structures, of which only a few may be briefly indicated.

Great tunnel projects included completion of the six-mile Moffat Tunnel under James Peak,

Colo., and the two-mile Holland Tunnel for vehicles under the Hudson at New York, and near completion of the Oakland Estuary Tube, largest subaqueous tunnel, connecting Oakland and Alameda, Calif.

The Carquenes Straits Bridge in California, noted for two long spans of 1100 feet each, was completed. Work began on the Poughkeepsie and Fort Lee highway bridges across the Hudson River while preparations were laid for the Hudson River suspension bridge at 37th Street, New York, 7000 feet between abutments, and for the Detroit-Windsor highway suspension bridge across the Detroit River, main span 1830 feet.

In the United States approximately 25,000 miles of new highways were built.

The Muscle Shoals power development saw six of the eight turbines installed, with a total capacity of 190,000 horsepower. The 4800-foot Conowingo dam and power house were being built near the mouth of the Susquehanna River to supply 378,000 horsepower. The Pacific Coast hydro-electric development includes three high-head plants, highest in the United States.

Important structures of the year cost about one thousand million dollars.

METEOROLOGY

CHARLES F. MARVIN

Chief of the U. S. Weather Bureau



PRACTICAL applications of meteorology to human welfare are the achievements that claim distinction. The year's noteworthy service of this science was that performed during the great Mississippi River flood.

Flood warnings of vital importance were given long in advance, and bulletins announcing even the

progress of inundations were the means of saving many lives and millions of dollars in property. Concerning the value of the flood bulletins, one of the high officials directing relief work said:

"They (the bulletins) were based upon a technical understanding and experience that were almost uncanny. We came to rely upon them and to build the whole organization and direction of our rescue operations upon them."

Little by little the meteorologist is extending his network of reporting stations to embrace more completely than ever before conditions over the oceans. Radio now makes this practicable, and trans-oceanic aural navigation is now the chief reason for it.

MEDICINE AND HEALTH

MORRIS FISHBEIN, M. D.

Editor, Journal of the American Medical Association



GREAT medical discoveries today are the results of the cumulative research of many years. An outstanding announcement in 1927 was the Noguchi germ for trachoma, infectious granulation of the eyelids. Small, of

Philadelphia, announced a specific organism for rheumatic fever. Neither investigation has been confirmed.

Whitaker of Boston seems to have shown that stasis, or lack of contraction of the gall bladder, is significant in the formation of gallstones, and a Japanese investigator has submitted evidence that absence of certain vitamins from the diet may be significant in stone formation in the gall-bladder, kidneys, or elsewhere in the body.

Much work has been done on Vitamin E, presumably associated with sterility, and also with iron metabolism.

Ultra-violet rays and other forms of phototherapy have been greatly studied. It has been found that irradiation of a mother will cause the rickets-preventing vitamin to appear in the milk. Irradiation of such cereals as oatmeal, barley, or rye provides them with the same vitamin.

In the treatment of undulant fever, acriflavine, a dye substance, has been found to have almost specific properties.

In the treatment of erysipelas, the antitoxin developed by Birkhaug has been found to have remarkable virtues. Possibly a similar antitoxin may be developed for the streptococcus that causes puerperal fever, and for the measles germ.

AVIATION

ALEXANDER KLEMIN, Sc. M.

Professor of Aeronautics, New York University



THE year has been crowded with achievements in commercial and technical aviation.

The Packard Company has built the world's largest aero engine, of 1900 horsepower. The air-cooled Pratt and

Whitney "Hornet" has passed into service use, delivering 523 horsepower and weighing only 730 pounds. Aero engines weighing only a pound per horsepower are in sight.

The Fairchild-Camines engine has passed its fifty-hour endurance test. In this novel four-cylinder engine, the pistons act on a single cam through rollers dispensing with crank and connecting rod.

For the first time airplane factories are unable to fill orders. Two plants are each turning out three planes a day.

On commercial planes we now find such features as: Independent wheel brakes permitting landing in small fields; landing gear eliminating bouncing cabins inclosed with no sacrifice of vision.

The British have developed a lateral control which eliminates danger of the dreaded spin after "stalling."

Soon we shall see: Nothing but air-cooled engines, of greatest reliability and simplicity; airplanes built entirely of metal, probably duralumin, huge passenger planes, with multi-engine units; night flying passenger lines, with comfortable sleepers; heavy fuel oil aero engines, reducing fire hazard to a minimum.

COMMUNICATION

JOHN MILLS, B.S., A.M.

Director of Publications, Bell Telephone Laboratories



TELEVISION — the transmission of distant scenes both by wire and by radio and their electrical recreation — will stand in the history of communication as the spectacular accomplishment of 1927.

Twelve years earlier was the corresponding achievement of trans-Atlantic radiotelephony.

Between such scientific demonstrations, however, and day-by-day commercial utilization, a period of development must

always intervene, although not always lengthened by the distractions of war. For radiotelephony, which was thus interrupted, 1927 saw a climax in the orderly establishment of two-way service between England and every section of our country.

Another instance of international co-operation was signalled by the opening of telephone communication with Mexico. Less in the public eye during the year, but economically of great value, were the development of magnetic cores from powdered permalloy, extensions of telephoto service, of high speed permalloy-loaded submarine cables and of storm-proof aerial toll cables on land.

AGRICULTURE

D. T. MACDOUGAL,
M.S., Ph.D., LL.D.

*Director, Department of Botanical Research,
Carnegie Institution*



PROGRESS in agriculture has been chiefly in fields already well defined. Improvements in methods of soil fertilization have followed studies of the balance of common salts, and by establishing that minute

traces of some substances, such as boron, are necessary. New evidence indicates that plants are benefited by being furnished carbon dioxide through the roots as well as the leaves.

Determinations of the time at which fertilizing salts may be most profitably added to the soil have yielded valuable information. Breeding experiments have yielded new strains of fruits and cereals of possible value in resisting disease, increasing yields and improving qualities.

Manufactured articles of rubber grown within the United States from the desert rubber plant of the southwest appeared.

There is a tendency to make farm engineering practice more profitable.

ARCHEOLOGY

NEIL M. JUDD, A.M.

Curator American Archaeology, U. S. National Museum



PROGRESS in American archaeology throughout 1927 brought more certain understanding of American prehistory. The Smithsonian Institution again turned toward Alaska and the Northwest

Coast, seeking definite clue of human migrations from Asia, most credited cradle of mankind. Ohio State Historical Society and the University of Chicago investigated monuments erected by the so-called Mound Builders of the Ohio Valley.

In Latin America, the Carnegie Institution of Washington continued its exploration of Chichen Itza, famed Maya city in northern Yucatan. The outstanding achievement of American archaeology in 1927 was excavation, by Earl H. Morris, and the restoration of the monumental Temple of the Warriors.

ELECTRICAL ENGINEERING

E. M. HERR, Ph.B., D.Sc.

President, Westinghouse Electric and Manufacturing Company



ONE of the fields in which electrical engineering has made a noteworthy program during the year is that pertaining to automatic control of electrical apparatus, in order to reduce to a minimum the amount of neces-

sary human labor and attention in power houses, sub-stations, and elsewhere.

Much of this work has been along the line of developing well-known devices, including photo-electric cells and sound-sensitive relays, but a really new invention was the Knowles grid-glow tube, a relay which can be operated by merely the capacity of an approaching object.

The use of arc-welding as a substitute for riveting in steel buildings, bridges, and other structures is another rapidly developing application of electricity.

Among other recent advances are turbine-generators running in an atmosphere of hydrogen to increase efficiency; the construction of the largest circuit-breakers, transformers, and self-cooled regulators so far built, insulation suitable for greatly increased voltages, a method for transmitting bulk power over distances of 500 miles or more; and the design of large Diesel-electric units for operating locomotives, cars, and ships.

PHOTOGRAPHY

C. E. KENNETH MERR, D.Sc.

Director, Research Laboratory, Eastman Kodak Company



IT HAS always been assumed that red and yellow objects must photograph as dark, and blue objects as light, so that the blue-eyed baby will screen with pale and watery eyes and the red-haired vixen

of the screen appears as a brunette. The camera men in 1927, however, have adopted the new panchromatic film, which is strongly sensitive to red and yellow, so that this time-honored belief is no longer true of the motion pictures.

While professional camera men are taking advantage of every improvement in their art a new horde of amateur movie enthusiasts is rivaling them. The amateur cameras are numbered by the thousand, and new accessories are placed on the market every week.

The combination of gramophone and motion picture has been supplemented by "talking movies" in which the sound is reproduced from a record on the film.

Perhaps the most striking novelty in still photography has been the commercial introduction of automatic cameras which make a series of portraits in return for a quarter inserted in a slot.

In a quite different field bankers have shown interest in a new camera for the

photography of large numbers of checks on a strip of film.

Another special camera is intended to photograph any intruder in a building which it guards without revealing its presence.

PSYCHOLOGY

PRESCOTT LECKY, A.M.

Department of Psychology, Columbia University

THIS has been a year of exceptional activity in psychological laboratories throughout the world.

The first scale of mental measurement

to have a zero point is the result of three years' research by Prof. E. L. Thorndike and his associates of the Institute of Educational Research. Heretofore it has not been possible, for example, to say that one subject was twice as intelligent

as another. The new group of tests makes such comparisons possible. The scale comprises series of problems in completion, arithmetic, vocabulary, and ability to follow directions.

Prof. Spearman of London has recently offered mathematical proof of his theory of a general factor of intelligence underlying all special abilities. According to this theory, persons who possess high-level ability in one function would be expected to show a certain superiority in other respects also, and vice versa.

A highly significant investigation in the field of character and personality traits is being conducted by a branch of the Institute of Educational Research headed by Drs. Hugh Hartshorne and Mark A. May. Exceedingly ingenious tests have been devised for the study of cheating, self-control, cooperation and so on.

Interest in animal psychology has received great impetus. At Columbia, a five-year program of research on the subject of animal drives—hunger, sex, and the like—has yielded unusual results.

PHYSICS

LYMAN J. BRIGGS, Ph.D.

*Assistant Director for Research and Testing,
U. S. Bureau of Standards*



A REMARK-ABLE new theory of the mechanics of atoms, supplied by the Swiss physicist Schrödinger, was an outstanding achievement in the realm of physics. It supplied an answer to the problem of why ordinary mechanics

cannot be applied to systems of atomic dimensions.

Briefly, the theory states that points or units of matter, such as electrons, are actually nothing but wave systems, just as ordinary light and X-rays are systems of waves. If the theory is sound, we should expect electrons to be scattered by a crystal, somewhat as X-rays are diffracted. This (Continued on page 114)

Three Captains

Skill, hate, reckless courage crowded into one flaming hour of the fire boat service

By KARL W. DETZER

Illustrated by W. J. Aylward

THE brothers McCarty quarreled over a girl. Her name was Helen. She tipped up her chin jauntily when she met the brothers on the street, so that they glowered suspiciously one at another and at all other men.

Joe was the elder, a long-armed giant, slow of speech. At twenty-three he labored heartily aboard Great Lakes timber schooners, or signed for short voyages on hookers and little rabbit cargo boats out of Chicago for Green Bay, Grand Traverse and the north ports. Long cruises took him into the blue, icy waters of Superior, and when he returned his lips were grim, as if the chill of the lake had crawled up through the deck planks, through his boot soles, and into the very heart of him.

He always sought out his younger brother, Michael, as soon as his ship touched the pier.

"How's she?"

"Um," Michael would answer, "blasted pretty."

"It's so," Joe always agreed, "I'll go see her."

Michael was a horseman then, on Fire Engine 13, just north of the new Lake Street elevated railway on Dearborn Street. Those were the days of twenty-four-hour shifts and no platoon. Only one evening in ten could Mike go to see the girl. Often on that night he met Joe there. For a time the rivalry was friendly enough.

Then one evening the sailor Joe appeared, purple of face, in front of the quarters of Fire Engine 13. He had returned that forenoon from a three-week voyage to Canadian ports. He had gone at once to Helen's house, and not found her there. But he had heard news, and he blamed his brother.

Mike, he cried, "would you come and fight for her?"

"More than that. I'll kill him as raises voice ag'in' her?"

"Where's she gone?" Joe demanded. "Where've you took her?"

"I've no notion," Michael replied truthfully; then, sensing the thought in Joe's hot mind, he added, "I wish I had, and be hanged to you!"

That was the last they said for many years, either one to the other. Bare fist to bare fist they fought, till firemen pulled them apart and a friendly patrolman took Joe home. Both stared straight ahead when they passed on the street after that. Each



From the quarters of Fire Engine 13, Michael saw her many summer afternoons as she passed south on Dearborn Street, the child beside her. Even then Michael saw a hot flash of maternal inheritance in the boy's thin face. Young Will Harrison was his mother's son.

blamed the other; both blamed Harrison the florist for the girl Helen, laughing at the two McCarty's, had slipped away with a thin-checked cultivator of carnations this was in the McKinley administration and had married him.

When the florist died eighteen months later, leaving a son, there was a shameful satisfaction in the hearts of the two brothers. Each thought, greedily, of offering Helen help. But neither did.

Joe saw her only twice in the next dozen years. Each time he wondered how beauty could disappear overnight. Michael saw her oftener. From the open door of Company 13's engine house, he watched her many summer afternoons as she passed south on Dearborn Street, the child beside her. Even then Michael saw a hot flash of maternal inheritance in the boy's thin face. Young Will Harrison was his mother's son.

When the boy was twelve, a short-legged ragamuffin on riverside wharves, the girl Helen died. Once more the brothers McCarty offered no help. Doggedly they clung to their quarrel, and to the life tasks they had set themselves.



Men crowded into the weak, makeshift fortresses of floating oil-spill containers. The place like a huge torch, set wood and water and steel in a glare of incandescent illumination.

Joe remained aloft. Michael slept fitfully, one ear alert for the clatter of night alarms. Sail gave way to steam on the Great Lakes. In the fire department the smell of leather and sweat yielded to gasoline and hot, oily steel. The sailor Joe became wheelman on a passenger vessel plying between Chicago and Ludington when canvas and cordage had finally vanished. Three years later he got his papers as third officer. He was a thorough, steady, close-lipped seaman, trustworthy and loyal. When the steamer, having outlived its usefulness to passengers, was sent one autumn to Northern Peninsula ports under ballast to bring home a cargo of canned apples, it broke up off the Manitou Islands and the crew came ashore in boats.

MIKE heard of the wreck. But he said nothing to Joe about it. The next spring Joe was signed as first officer on the tanker *Salem*, a new steel vessel operated by that organization familiarly called the "trust" on the Lakes. She was not a pretty craft. She lay long and low upon the water, with a tall Texas poking up forward and a high cabin aft over the engine room. Three hundred and ten feet over all, with a beam of

thirty-six feet and a draft of eighteen when loaded, her steel hull was divided into seven tanks of three thousand barrels each.

Joe McCarty served for eight seasons as first officer on the *Salem*. When her master died in his chart room one night off the Huron Thumb, Joe brought the tanker safely into port. He signed interment documents and shortly became Captain Joe. That was three years ago now. He was fifty-nine years old and the way he had come was a hard one.

Michael rode seat, box and tailboard of many a Chicago hose wagon in the meantime; was shifted from company to company, from engine to flying squadron to ladder truck. He was senior pipeman on Engine 32 when the Iroquois Theater burned. At the great fire in the Yards, when the chief of department and twenty other valiant fighters died under a beef house wall, he served as lieutenant on a ladder truck, laboring till his great hands blistered and bled, striving to save his comrades.

Shortly afterward he captained Engine 27 on North Wells Street. Years piled upon his back; he missed his brother; in his heart grew a biting resentment against him.

He saw Joe only occasionally on the street. The son of the



Captain Michael McCarty lay on the blistered deck of his men fire tug when consciousness came back to him. Beside him was the great long-armed sailor Jim. The blazing Salm was sinking

girl he had loved he came across often. Young Will Harrison loafed frequently on the docks near the Boulevard bridge. He worked as a roustabout on the river lighter *Crane* the year he was twenty-one. He looked like a sailor at twenty-five—a shiftless sailor on a ragged vessel.

In the blaze that goes down in fire department history as the "Harrington fire," Captain Michael McCarty was routed out at four in the morning on the second special alarm. He commanded one of the thirty-nine engines laboring against that mighty enemy, a night. He faced unbearable heat for sixteen ghastly hours and at length dropped.

At the hospital a dapper young physician prescribed rest
'And plenty of fresh air,' he added.

MICHAEL glared at him through the bandages. But officials of the department, hoping to save a good man, put him in command of a fire boat in Chicago River old Engine 31, at the foot of LaSalle Street.

That, too, was three years ago. Michael McCarty was fifty-six.

The captain of a fire tug is not of necessity a seaman. While the vessel is under way, he turns over command to a licensed pilot. Once at the fire, he is aboard ship, on the river banks or lake shore, he again assumes control, to drive his vessel stubbornly, bullily it, risk its life.

Fire Tug 97 was a neat craft, broad waisted, low in the water, enlivened here and there with shining brass and departmental crimson. Her high bridge commanded two iron turrets, each with its jowly water gun. These cannons spit hearty streams from their three-inch muzzles, streams that could bore a way through a brick wall at seventy feet. A line of hydrants pro-

truded along each side of the cabin. Two of these had gaping mouths, six inches wide, to pour their volume into the gigantic boat hose.

Michael McCarty took grim pride in his command.

"She ain't ever traveled far," he would say lightly, as he watched passenger vessels and freighters ply up and down the lake, "not far. To hell and back about ten times a year, that's all."

A crew of nine huskies manned the boat. They were hard-bitten old firemen, seamen from the Lakes. Donley was senior pipeman and first mate—Free Silver Donley, who wore the scars of a dozen stubborn fires. There were Swensen and Burneister, plain, gray-wrinkled old men with the mark of salt. There was Cork, the fighter. There were Cohen and Maloney and Smith, with seven years each in the service, and the two recruits, Whipple and O'Day.

The crew had learned never to mention Captain Joe McCarty to his brother Mike. The older ones knew Joe.

"And a thin piece of hose he is, was you to ask me," said Senior Pipeman Donley, who understood the meaning of loyalty. "What'd they fight about? Oh, a girl!" He spat deliberately into the river. "I heard her name once. Forgot it now."

Captain Michael, brooding on his forward deck, came to the same conclusion after many years. The name Harrison was not worth remembering. After all, it belonged only to a florist and now to a roustabout son. It was the girl named Helen who had counted.

Mike had not seen the son for two years that August afternoon when a tramp steamer put in from Lake Michigan and pawed up the stream with clumsy antics. All tramps angered his orderly mind. This one was rusty. (Continued on page 115)

MARCONI Tells— What Radio Needs

The Celebrated Inventor of Wireless Peers into the Future

By FRANK PARKER STOCKBRIDGE

TWENTY-FIVE years ago I stood on Table Head, Cape Breton Island, looking out across the Atlantic. The black smoke of a steamship, hull down beyond the horizon, was the only thing visible to seaward besides the lowering sky and the turbulent ocean. The slender, blond, boyish man of twenty-eight who stood beside me waved his hand.

"Right out there," said Guglielmo Marconi, in the perfect English learned from his Irish mother, "not a hundred miles from where that ship is, *La Bourgogne* sank with the loss of nearly all on board, although she was within fifty miles of half a dozen ships. Her captain had no way of calling help.

"Some day," he went on, "every ship will be equipped with wireless, even freighters. Wireless will avert another such disaster as that of *La Bourgogne*."

SIXTEEN hundred miles and more in front of us, as we stood there at Glace Bay, lay Poldhu, on the Cornish coast. Behind us loomed the four great skeleton towers, with their high antennae glittering in the reflection from the snow. And in the low, wooden shack at the foot of the towers I had stood with Marconi the night before and had seen the first message come in from Cornwall.

Dot-dot-dot dash-dot. "S N," Morse slang for "I understand."

From the dimly lighted, almost windowless shack, a few seconds earlier, we had broadcast our own message: "Do you get us?" Outside a storm raged. Vivid lightning and a startling aurora borealis played brilliant and ghastly lights upon the towers. A worse night for an experiment with wireless could not be imagined, but the equipment was ready and Marconi was impatient.

"**S**OME day wireless will work in spite of such disturbances," he said. "Perhaps it will now. We'll try."

The crash of the two-foot spark with its fifty thousand volts drowns the roar of the storm. Dash-dot-dot! Dash-dot dash-dash! Blue flames race and crackle along the aërials. Miners, they tell us afterwards in the village, cross themselves and pray for delivery from these strange new devils of the wireless!



Marconi, father of radio, who predicts power transmission through the air and calls on inventive Americans to help to make it a reality

C. S. Franklin, Marconi's chief research engineer, testing a short wave radio receiver, getting signals from parabolic reflector which is illustrated on page 32



as the congratulatory wires flow in on the morrow. "I knew it would work," he says.

A few days ago I visited Marconi again. This time he was in an apartment at the Ritz-Carlton hotel in New York, enjoying a "business holiday"—listening to a radio concert!

"We didn't imagine anything like this, when we were up there trying to get intelligible signals across the Atlantic," he said, waving his hand toward the loop aerial of the portable receiving set.

"No; and the things you did imagine, people wouldn't believe," I replied. "Times have changed, now the public will believe that anything is possible by means of radio."

"That is why I would rather talk about the limitations

Slowly the sparks spell out our message. Then we wait. Marconi puts on a telephone headpiece. His assistant adjusts the tape of the siphon recorder. I watch the coherer.

Suddenly Marconi lifts his hand. "A signal!" he exclaims.

The siphon needle dips. The tiny particles of gold leaf in the coherer rush together and as suddenly fall apart, only to repeat the action.

"Did you get it?" Marconi asks.

"It looked like three dots and a dash-dot," I reply.

"Here it is, on the tape," says the assistant. Poldhu has heard and answered us!

I plow my way through the storm to the cottage, call the waiting telegraph operator at Sydney, and announce to a skeptical world that Marconi has really done it. He shows no evidence of pride

of wireless—radio seems to be the preferred term in America—than about its possibilities in the future," he replied, smiling. It was the same companionable smile at fifty-three that I had known at twenty-eight.

"**W**HAT has been achieved in radio has been the work not of any one man, but of thousands," he went on. "Many of the most valuable advances have been the work of enthusiastic amateurs. There are thousands of experimenters, but there is room for thousands more. Nowhere are there so many young men interested in radio as in America, and I am hopeful that as the result of that interest we may find out some of the things we don't yet know."

"Such as—" I suggested.

"What causes fading, and how to overcome it. That would be a good place for any young man to start who wants to win enduring fame and, incidentally, make a great deal of money," Marconi replied.

"Fading has been partially overcome by the use of reflectors in the short-wave beam system which is now in operation between England and Australia, India, South Africa, Canada and the United States. By these reflectors the waves are all sent in a single direction, and so are received with a strength of more than one hundred times that which would be possible without the reflectors. But this method is not applicable to broadcasting. Even with the beam system, fading often gives a great deal of trouble, though it is at its worst on wave lengths between 200 and 1000 meters.

"The very short waves and the very long ones do not seem to be so much affected as those in the middle ranges. We use waves of from sixteen to thirty-two meters for the beam system connecting the British Dominions with England, and often when the longer of these waves do not get through we get perfect communication with the sixteen meter waves.

"**H**OW the waves travel around the earth is another question. We used to say they traveled through ether, but now science is discarding the ether theory.

"Another mystery is just how the position and altitude of the sun affects the radio waves. While we have found that the very short waves are received better by day and in the summer than at night or in winter, we have also found that in long-distance transmission the waves prefer the route which is the least exposed to the sun. In the morning they travel southwestward 14,000 miles from England to Melbourne, in the afternoon they go the other way—only 10,000 miles.

"Another problem is that of skip-distances. Nobody has yet discovered why at one point reception may be perfect while at another point in precisely the same line the waves are not perceptible at all. Some day some radioexperimenter will find the reason and the remedy."

"You regard the short wave, then, as the most promising field?" I asked.

"I think the possibilities of the directed short wave are only now beginning to be realized," Marconi replied. "For the last ten years I have confined my researches to this field, and while the results have been very great, there are even greater possibilities ahead.

"One advantage is the small amount of power required. We use only twenty kilowatts for communications between England and Australia.

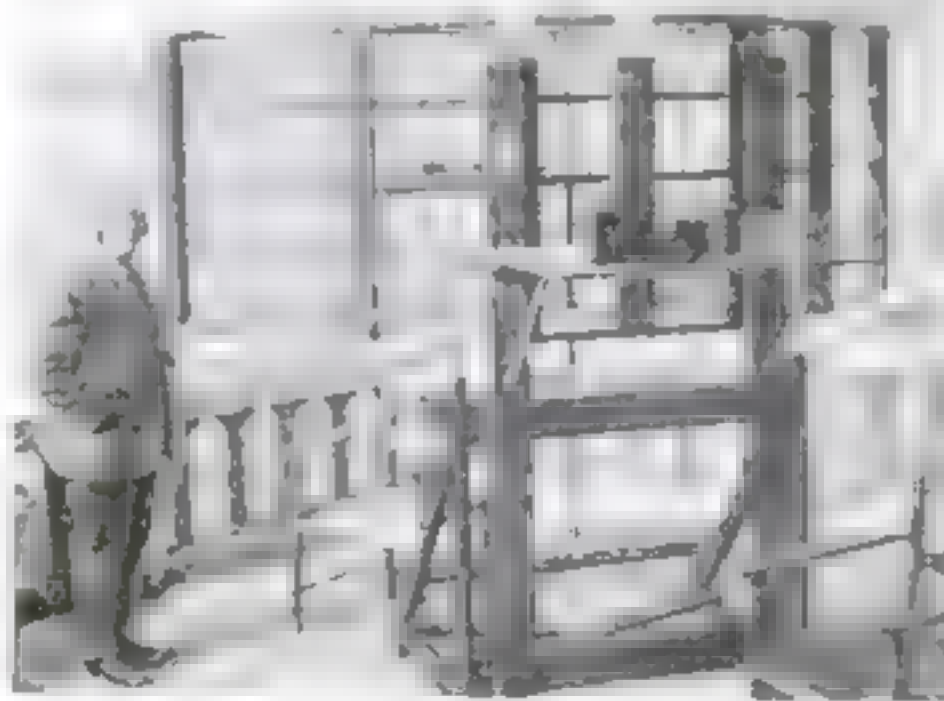
"What of the application of short waves to broadcasting?"

"There are great possibilities, and I look for important results from the



The parabolic reflector at Hendon, Eng. used by Marconi in experiments with directed short radio waves, in which he believes lie the greatest possibilities for further advance in radio

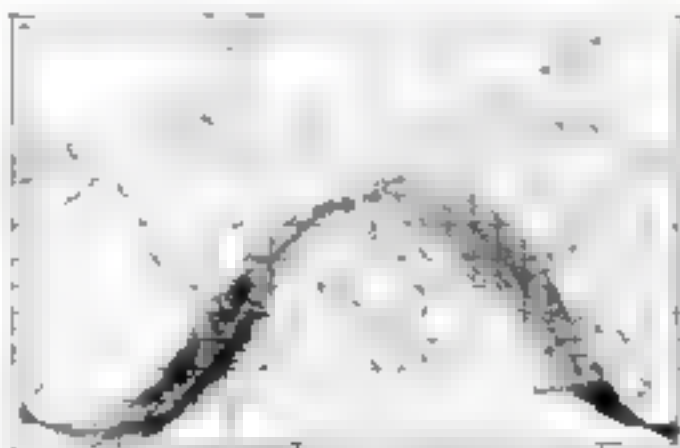
experiments being made at station WGY, at Schenectady, with the five-meter waves. At present the value of the short wave in broadcasting is in hooking up distant stations. We can use the reflected short-wave beam for telephony with great economy and splendid results, the



A parabolic reflector of the short wave beam radio system and C. S. Franklin, Marconi aide, who has won fame by his part in developing the system. The scene is the Marconi plant at Livorno, Italy

same waves carrying telegrams and voice waves. It will be easily possible to hook up the United States with any other part of the world where the short wave beam system is in operation.

Incidentally, the new short wave beam stations just erected on Long Island will, I expect, shortly have the effect of greatly reducing the cost of telephone



How the beam radio short waves prefer the route least exposed to the sun from England to Australia. Mornings they go westward, and afternoons, eastward

conversation across the Atlantic."

"What other advances in radio do you look for?" I inquired.

"I think it certain that there will be great improvements in the vacuum tubes for detecting and amplifying signals," he said, "although the present tubes are a great advance over the primitive coherers which you saw at Glace Bay."

In the light of the experience of twenty five years since then, have you no predictions to compare with those you made then, and which have since come true?" I persisted.

"From my limited point of view, I should say that the developments in which the directed short wave will play an important part will be in the fields of direction finding

for ships and aircraft, in the control of mechanism at a distance, in the facsimile transmission of messages and pictures over long distances, in television, and in the transmission of power. They may render solar observations and the magnetic compass obsolete.

"America is already far ahead of the rest of the world in the control of mechanism by radio, for which the beam system is peculiarly adapted. Boats, aircraft, machines, all may be set in motion, directed and stopped by radio. It is conceivable that a radio wave originating in America may start and stop the wheels of industry in South Africa or Siberia.

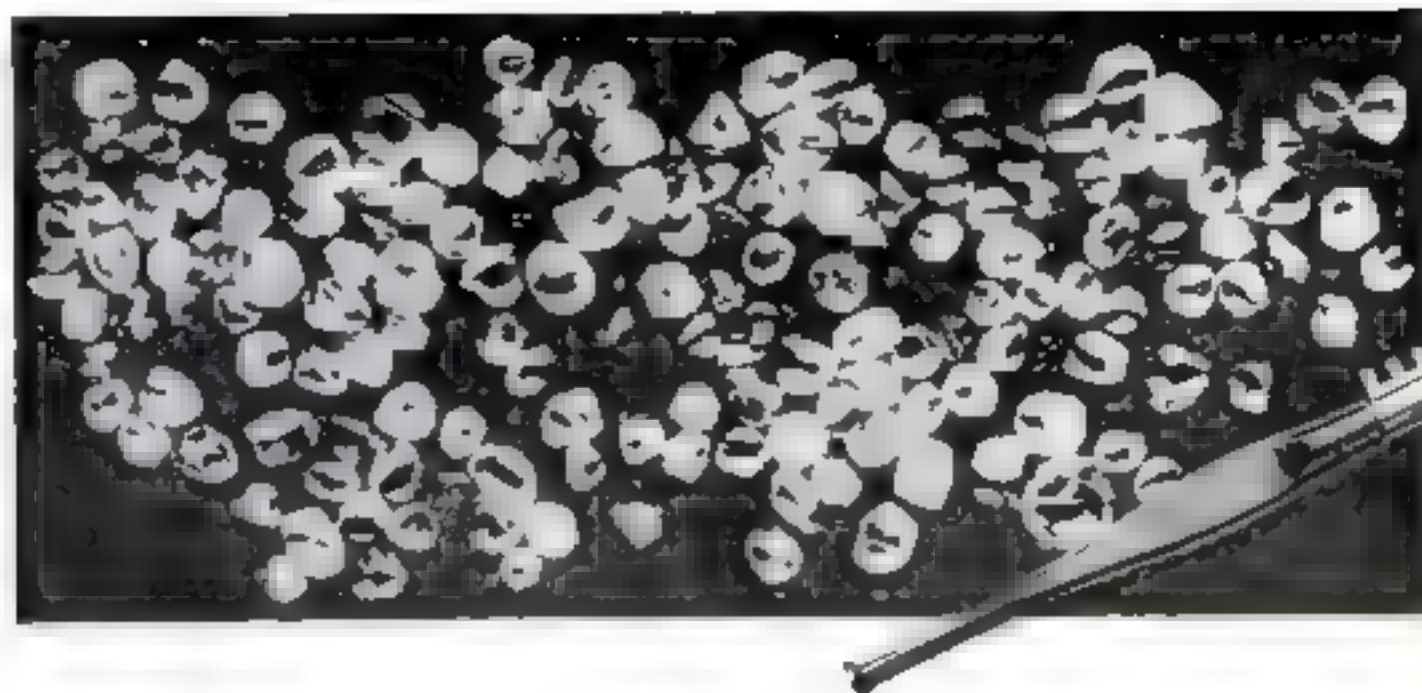
"**A**S to the facsimile transmission of messages over long distances, that is already being done both by wire and radio on a limited scale. I believe that within a year it will be an established commercial method. Its adoption will render the Morse code obsolete.

"Television already has been achieved and its general use is close at hand—just how close I would not care to predict. I look for the development of television to the point where the action in a whole race course or football field can be shown at a distance. I cannot foresee as a commercial possibility television in the home, but it is a possibility for theaters.

As to transmission of power—well, that, perhaps, is something for which I may again be called visionary. With the concentration of the radio beam to the point of no divergence of the rays from parallelism, I believe that in time we shall find ways to impress huge volumes of power upon the transmitting mechanism and to receive practically all of that power over distances of perhaps twenty miles."

"Will radio ever supplant telegraph and telephone wire systems?"

"I don't think it will supplant them so much as extend them," Marconi replied. "I do not imagine there will be any great system of telegraph and telephone wires in undeveloped regions like Africa, Asia, South America and Australia—radio will serve every purpose. I do not believe existing telephone and telegraph systems will be scrapped, however."



A handful of
black diamond
fragments worth
\$1,000, and a
small cutter
whose wheel is
made from one

Gems that Work for a Living

*Black Diamonds, the Most Precious Stones
on Earth, Put to Curious Industrial Uses*

By ORVILLE H. KNEEN

ON YOUR mountain hikes some day you may come to a dry creek bed showing bits of gray granite, sparkling quartzite, or pieces of conglomerate, rounded stones set firmly in natural cement. You may spy a dark colored pebble, perhaps tinted green, brown or gray. Unlike the stones worn smooth with ages of water action, this pebble may have sharp edges and corners. Broken with a sharp blow, the gray interior may look like close-grained steel, and you may find that it will scratch the hardest surface.

If your find is the size of a baseball and proves to be pure carbon weighing around a pound and a quarter, your lucky bank account will swell at least \$75,000. If the defects are slight and the hardness the greatest, the figure may be \$500,000. Such is the esteem in which this lusterless member of the diamond family is held by industry today.

Just such a "black diamond" was picked up by a naked black miner in Brazil some thirty-two years ago, and even at the low prices of that day it brought him \$10,000. Weighing 31.50 carats, it was exported to Paris, broken up into more useful stones of three to six carats each, and then sold for a vastly greater amount than the finder received.

brilliant branch of the family. Like the gems, they are ninety-eight and a half percent or more pure carbon. But there is this vital difference. When you strike your diamond ring on a sharp edge of rock, a corner of the diamond may fly off. That is because the crystals are composed of layers, rendering them too fragile for heavy cutting purposes. Now these tough black carbons are made up of tenacious clusters of im-

perfect crystals, which resist fracture so stubbornly that a force of over four tons per square inch is necessary to tear them apart.

NOW here is a carbon in a steel setting, which will eat through the hardest steel as though it were cheese. Notice that the diamond is deeply imbedded, only about one-thirty-second-inch projecting. Such a tool recently turned the hardest automobile crank shafts for over six months without care or attention. An identical stone, carefully turned and reset to bring out new cutting edges, lasted eleven months on the same job.

Almost a year, day after day, cutting hundreds of miles of shavings from the most tenacious steel made! I began to see why black diamonds are the most precious substance in industry. The United States Mint says that a troy ounce of gold is always worth \$20.67, plus a few mills. Platinum brings about \$70 an ounce. At \$25 to \$150 a carat, and 1-1/2 carats to the ounce, black diamonds bring from \$3600 to \$22,725 per troy ounce—double the value of rough sparklers at the mines!

I asked Edward Katz, of the Diamond Drill Carbon Company, importers and setters of black



A carbon mine in Fabis, Brazil, being worked by natives in primitive manner

A New York dealer showed me ten rough-looking rocks, about the size of large irregular peas.

"These are the most useful size—there are about forty-five carats here," he said. "Their value? Oh, roughly about \$7000. They are the hardest things in the world, and far tougher even than the



Natives washing and sifting gravel for black diamonds in Fabis, Brazil. Their salary for this back-breaking labor is only a dollar and three cents a week, but they get a percentage of the proceeds of their finds

(Continued on page 112)



World-Wide Building of Giant Balloons Is Under Way for Spectacular Contest With Winged Craft for Air Supremacy

By GEORGE LEE DOWD, JR.

FOR a year the airplane has monopolized the limelight. In the heroic drama of the skies, it has reaped all the glory—and the tragedy. But in the coming months, unless all signs fail, the winged ship is to encounter a formidable rival. It is the dirigible.

For dirigible engineers at home and abroad have been quietly at work, almost unnoticed preparing the next spectacular race for air supremacy.

The British Navy is completing two dirigible cruisers, the *R-100* and *R-101*—one a military, the other a commercial ship—each with twice the gas capacity of our own airship *Los Angeles*. They are to sail with passengers and cargoes from London to India, Egypt, South Africa, Australia and Canada. In Germany, the Zeppelin factory is finishing a ship nearly as large, the *LZ-127*, to fly between Europe and the United States, and is starting a larger one. Spain has ordered a Zeppelin from Germany for air service to South America.

AND the United States Navy has approved designs for the largest lighter-than-air ship in the world, a military dreadnaught three times as large as the ill-fated *Shenandoah*, with a length of 780 feet—longer than the ocean liner *Mauretania*—and with gas capacity of 8,500,000 cubic feet. Others of even greater size are on the program.

Designers of these mighty ships say the future of air travel and commerce,

especially over the longer distances, rests in their buoyancy and safety rather than in the speed of wings.

Are they right? Let's look at the facts:

First of all, speed is an important factor. Lieutenant Alford J. Williams, of the Navy, has driven a plane more than 300 miles an hour. The best commercial planes can do 200. Colonel Lindbergh flew across the Atlantic at an average of close to 110 miles an hour. But the best the *Los Angeles* can do is seventy-five miles an hour. Even the specifications for the Navy's new dirigible call for no greater speed than seventy knots, or eighty land miles an hour. For swiftness, then, the airplane remains supreme.

But the dirigible can travel farther and carry much heavier loads.

Clarence Chamberlin, hopping to Germany, covered 4100 miles before his last drop of fuel was gone. Lindbergh traveled 3600 miles to Paris; Byrd went about the same distance.

But the airship *Los Angeles*, carrying a crew of thirty-five, has a nonstop cruising radius of 6000 miles. And the Navy's new ship will go 11,000 miles without a halt—about three times as far as the best long-distance planes. Dr. Hugo

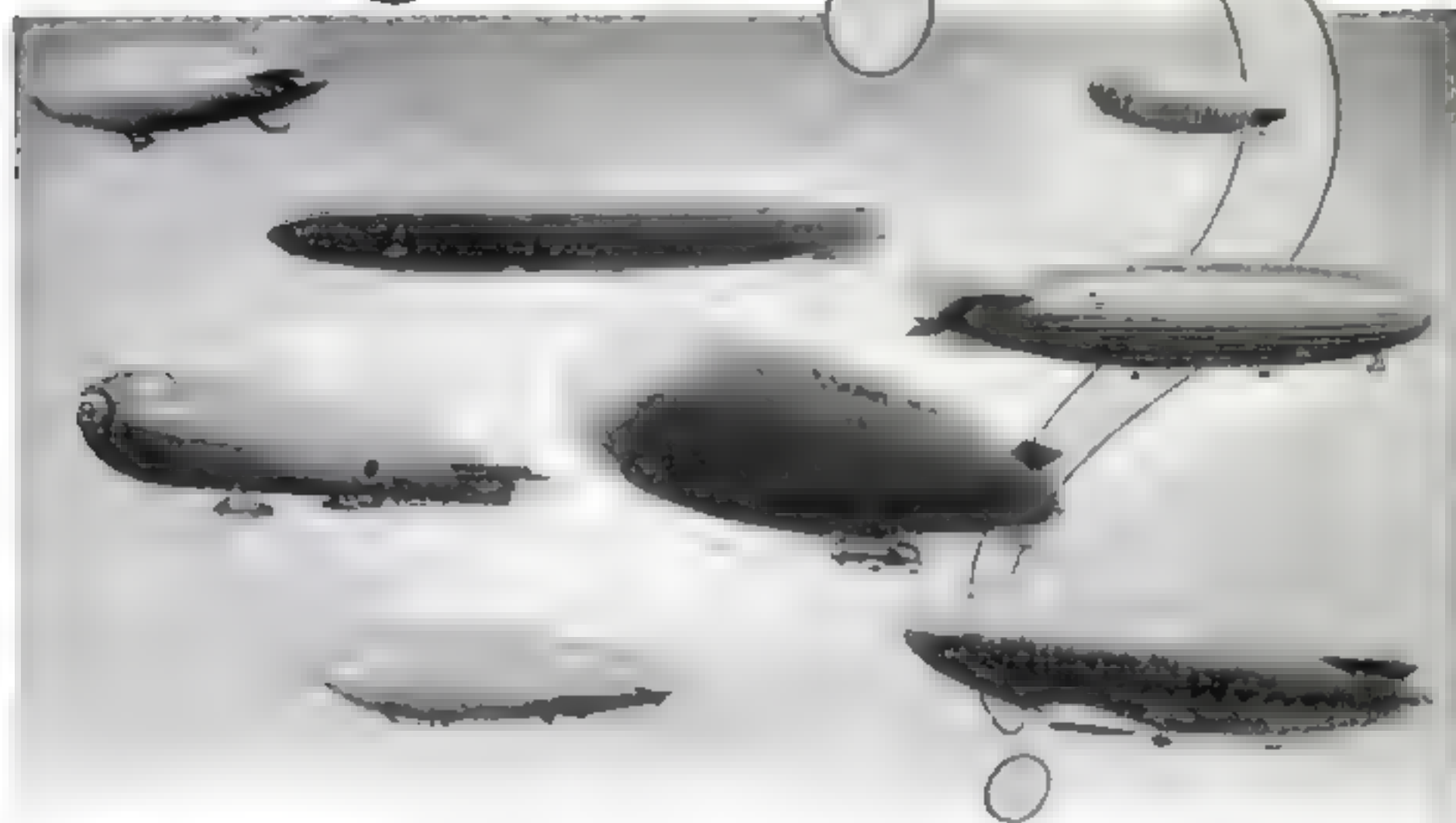
Eckener, head of the Zeppelin works in Germany, has declared that the *LZ-127* can circle the world in a single hop!

IN ACTUAL long-distance flights the airship appears to have surpassed its winged rivals. During the war the German dirigible *L 9* flew from Bulgaria to Central Africa and back, 4225 miles. The British *R-34* soared from England to the United States and back. The *Los Angeles* came here from Germany. Their hazardous westward ocean flights were feats airplanes have tried in vain. Before the Navy's *Shenandoah* was destroyed, she had completed a cruise of 9000 miles. And Amundsen's *Norge* flew from Rome to England, to Russia and Norway and across the North Pole to Alaska—6840 miles.

In carrying useful loads, especially over any distance, lighter-than-air craft again claim supremacy. Virtually every plane which attempted an ocean hop last year was taxed to the limit merely to lift and carry the fuel required. Passengers or cargo were out of the question.

In contrast, experts declare the Navy's new airship, when completed, will be able to cruise at seventy knots

Dirigibles



The rivalry in science a peaceful war for sky supremacy. Will planes or dirigibles win—or new balloons with fleet wings?

from San Francisco to Hawaii with a military load—soldiers and equipment—of thirty-four tons! At fifty knots she can make the same trip with forty-three tons. Moreover, the ship can carry five scouting airplanes, weighing a ton and a half each and capable of being launched and landed in mid-air.

SUCH tremendous lifting capacity, the experts point out, offers immense opportunities for paying commercial transportation. True, commercial airplanes carrying twenty passengers and more are operated successfully in Europe, and to a less extent larger passenger planes are being developed in America, but as Glenn Curtiss pointed out in the July *POPULAR SCIENCE MONTHLY*, for every pound of useful load capacity, more than a pound must be added to the basic weight of a plane. He declared that with our present knowledge, trans-Atlantic passenger airplanes would be unsafe and uneconomical.

And Professor Alexander Klemin, head of the Daniel Guggenheim School of Aeronautics, recently asserted that a fifty-ton plane with hundred-passenger capacity is about the limit of size.

With lighter-than-air ships, according to the designers, increasing the size from the 2,000,000-cubic-foot gas capacity of the *Los Angeles* to the 5,000,000-cubic-foot capacity of the new British ships means converting a more or less experimental plaything into a commercially paying transport.

Experts differ widely as to the com-

parative safety of the dirigible and the airplane, although the former would appear safer because of its natural buoyancy. Public confidence in the airplane which followed the successes of Landnigh and Chamberlin turned to dismay as flyer after flyer was lost in the sea. Even so was America's pride in the *Shenandoah* dashed, two years ago, when she cracked up in an Ohio storm.

Notwithstanding, the safety of both types of craft has increased rapidly. Improved designs, more reliable and powerful engines, and new instruments of navigation have helped the airplanes. Likewise, the new dirigible will be of sturdier construction, we are told, of lighter and stronger metals, and able to withstand the fiercest gales. The navigating car will be built into the bow. Engines will be built as integral parts of the keel. In the American ships, at least, danger from fires and explosions that destroyed the *ZR-3* and the *Hove* will be eliminated by the use of noninflammable helium gas for inflation. The German *LZ-127* will be built of metal twenty percent stronger than duralumin. It will use a new fuel gas called "etan" light as air, giving longer cruising range.

THE military value of the dirigible as compared with the airplane is another disputed question.

Naval authorities say that the chief purpose of America's new dirigible will be scouting and reconnoitering, for which this type of craft is far superior to planes. An airship can hover and observe

closely, while a plane must keep moving at high speed. In fourteen hours of daylight the air cruiser, to be built at a cost of \$5,000,000, will be able to scout a sea area of 85,000 square miles. Twelve such ships could scout our 5000 miles of coast.

THE ship will carry twenty-five machine guns and one automatic cannon. Rear Admiral William A. Moffett, Chief of the Bureau of Aeronautics, says:

"An enemy aircraft cannot approach from any angle without permitting a concentration of fire. The ship can be pierced with 200 holes and lose but 25 percent of gas volume in five hours."

In climbing ability the dirigible surpasses, and therefore should be valuable for bombing operations. A fast fighting plane requires forty-one minutes to climb 21,000 feet; a dirigible can rise at twice that speed. The big bombing planes reach their ceiling at 10,000 feet. The new Navy ship will go to 26,000.

From a military standpoint, the cost of a dirigible is comparatively small, but for commercial transportation, the price is all but prohibitive. For the \$5,000,000 to be paid for the new Navy ship, some fifty planes as large as Commander Byrd's *America* could be built.

It may be that the planes will eventually resign the goal of long-distance passenger and express service to the dirigibles, remaining content to serve as high-speed, short-distance carriers. Or aircraft of the future may combine the buoyancy of the gas-filled envelope and the fleet wings of the airplane.

Can You Say What You Mean?

Why with 455,000 Words Available Most of Us Bungle Along with Just a Few Thousand

By GEORGE McLEAN HARPER

Dr Harper, Professor of English Literature at Princeton University, is a leading authority on the English language. He is an experienced journalist as well as a teacher and is the author of a number of books on literature. During the war he was a member of the American Commission for Relief in Belgium.

HOW many words do you know how to use correctly? Or, to put it differently, how many do you use incorrectly in ordinary conversation and writing? Did you ever stop to test yourself, to measure your knowledge and command of the English language?

On the train the other day I overheard two young business men debating the use of the word "impractical." One had written an important letter containing the sentence: "It seems to us that your plan is impractical." His employer had put a blue pencil line beneath the word "impractical" and made the notation: "Wrong, better correct this."

"Sure you were wrong," his companion replied. "You should have said, 'the plan is impracticable.' It's all right to say a man is impractical, but not a plan."

I am quite sure that either would have been surprised to learn that both of them were wrong—that "impractical" is bad in either case, although it is entirely correct to speak of a man as "unpractical."

NO DOUBT you have listened of late to many such friendly controversies about the use of the right words in the right place, as well as about pronunciation. Possibly you have taken part in such debates yourself. For never before, I believe, have Americans shown such interest in the science of words, their history, meaning and right usage. The recent crossword puzzle craze was but one sign of this growing interest. You will find hardly an office or home where the dictionary has not become a well-thumbed volume. In workshops and factories, as in schools and colleges, is shown the same desire for closer working acquaintance with words—which, after all, are our chief vehicles for expressing ideas.

The same interest extends into public and political life. For example, when President Coolidge, a few months ago, issued his now famous statement, "I do not

choose to run for President in 1928," he aroused a nation-wide controversy which, at this writing, has not been settled. When he used the word "choose," exactly what did the President have in mind? Did he mean, as some contended, that he did not desire to be a candidate for a third term, but might consent if the demand were strong enough? Was his statement, on the other hand, to be construed as a definite refusal? Or, as many suggested, was "choose," as he used it in his statement to the press, what Theodore Roosevelt called a "weasel word"—an elusive word that might be used

in one way and understood in another?

Thousands of us consulted dictionaries and histories of the English language to learn, if possible, exactly how "choose" should be interpreted. But little light broke from those quarters. While the essential thought of the word, as it has come down from Anglo-Saxon origin, has been "to pick out," we found that in modern usage it can mean either to make a definite selection between alternatives, or merely to prefer, desire, or wish.

Finally, some one acquainted with the local usages of New England declared that if a Vermont farmer snapped his jaws and remarked, "I do not choose to sell you this horse," he meant, "I am determined not to."

Are These Sentences Right or Wrong?

SOME of the following sentences and phrases are correct, others incorrect. Mark after each one whether it is right or wrong, and underscore the word or words you believe wrong. Then turn to page 150 for the correct answers. If fifteen of your answers are correct your command of language is up to the average.

1. Pedestrians are liable to change their minds in the middle of the road and are therefore apt to be run over.
2. He deprecated the good qualities of my friend.
3. He deprecated my criticism.
4. Observation of the Sabbath.
5. Observance of the clouds.
6. The audience were sleepy.
7. The audience was large.
8. I rented a house to him.
9. I rented a house from him.
10. I built a home.
11. This is a supposititious case.
12. A supposititious child was palmed off on them.
13. Clubmen and others of that ilk.
14. I am disinterested in your scheme.
15. The speaker waited half an hour on his audience, and when they materialized he started his address.
16. The majority of the eggs proved rotten.
17. Do you anticipate that he will be elected?
18. He was rushed to the hospital.
19. I wrote him a letter.
20. I wrote him yesterday.
21. He substituted the catcher for the pitcher.
22. The news transpired next day.
23. The event transpired an hour before it was known to anybody.
24. Quite a few men were there.
25. I inquired as to whether he was going.

THE debate showed that people everywhere are concerned with the precise use of language. The reasons are not difficult to find. In the first place, we live in an increasingly complex age of specialization, which more and more is requiring precise and specific expression. Moreover, discoveries in science and invention, vastly extending our horizons of the world and the universe we live in, have necessitated a host of new words for the expression of new ideas. So that the man today who hopes to reach a high place of achievement in virtually any profession, trade or business must have a reasonably exact and extensive command of the language. Only the other day a brilliant mechanic, a foreman in a large machine shop, told me that the greatest obstacle in the way of his grasping higher opportunities was his inability to compete with others in the use of correct speech and writing. Now, past the age of forty, he is undertaking in spare hours a systematic study of language.

A second reason is the spread of elementary education which has caused millions of our people to take an intelligent interest in the origin and history of words and idioms. In many of our schools boys and girls are learning to seize upon unfamiliar words, trace their origins through centuries.

(Continued on page 147)



Famous patents.—Top, left to right, Lincoln, buoy; Prince Henry, windshield wiper; Jack Johnson, wrench; J. J. Astor, road cleaner; D. W. G., high pressure machine. Bottom, Charles Ray, signal; Sandow, dumb-bell; Plummer's, punching bag platform; Mark Twain, scrapbook; Oscar Hammerstein, cigar machine. Patenteers: Upper left, Lincoln; lower, Sandow; left center, Fitz; and most right center, Mark Twain; upper right, Griffith; lower, Hammerstein.

Invention—

By

AUBREY D. McFADYEN

Associate Examiner, U. S. Patent Office

Hobby of Great Men

How Lincoln, Mark Twain and Many Other Celebrities Patented Ideas

MORE than one million six hundred and fifty thousand patents have been granted by the United States of America since that last day of January, 1791, when George Washington as President and Thomas Jefferson as Secretary of State signed the first American patent, issued to Francis Bailey for a type punch.

From that day this has been literally a nation of inventors. To the question "Who invents all these things for which patents are issued?" the answer is literally: "Everybody." The records of the Patent Office do not distinguish between the professional inventor and the amateur, but the patentees include so many whose interest in invention is obviously secondary that it evokes no surprise when an eminent pianist takes out a patent on an automobile attachment, a famous pugilist invents a monkey wrench, or the scion of one of America's wealthiest families submits drawings for a shoe polishing device.

Every American, seemingly, is an actual or a potential inventor. And, curiously enough, many of their inventions work!

The backbone of the Patent Office, so to speak, is the professional inventor—

the man who makes a business of finding new ways to do things, or new things to do, in his own particular field, which is the field in which he earns his livelihood. Thomas A. Edison is one of the most prolific, with 1078 patents to his credit down to August, 1927; but the man who leads all is Ethan L. Dodds, of Central Valley, N. Y., who has taken out more than 1800 patents.

Mr. Dodds' patents all relate to rail-roading. His reputation is such that when he says a thing will work railroad companies go ahead and use it without waiting until somebody else experiments with it.

BUT for every Dodds and Edison and Peter Cooper Hewitt, the three most prolific professional inventors America has produced, there are several thousand amateur inventors, whose ideas are ingenious enough to be patentable but of doubtful commercial value.

That is true, for example, of the sole invention credited to Abraham Lincoln, the model of which is one of the few preserved by the Patent Office at Wash-

ington. For years the office required working models of all inventions to be filed with the applications, and the old model room was a veritable museum. That requirement was abrogated, but a few of the more historic and interesting old models have been kept, among them that on which Abraham Lincoln, of Springfield, Ill., obtained Patent No. 6462, on March 10, 1849, for a means of buoying vessels over shoals.

AS A young man Lincoln had made the trip by flatboat down the Ohio and Mississippi rivers to New Orleans, and had noted the troubles of navigators on the shoals. After steamboats had begun to replace flatboats he conceived the idea of attaching buoyant chambers, much like huge bellows, to the sides of the boats, to be inflated or otherwise forced open by the power of the engine when the steamboat went aground on a shoal. The added buoyancy was supposed to lighten the draft of the vessel so that it would float off the shoal. It is not of record that anybody ever tried Lincoln's invention.

Lincoln was not the only man to be-

come President of the United States who did a little inventing on the side, though he was the only one to take out a patent. George Washington and Thomas Jefferson were both inventors. In *POPULAR SCIENCE MONTHLY* for February, 1927, Jefferson's inventive turn was described at length. He originated the swivel chair, the folding buggy top, the three-legged folding camp stool, and the modern type of plowshare, among other inventions still in use today. A writing desk with an adjustable top, which could be folded for traveling, designed by Jefferson and possibly made by his own hands, though more probably by one of the Negro carpenters among his slaves, is preserved in the Smithsonian Institution at Washington.

GENERAL WASHINGTON'S inventions, recorded in his diary, include a "wine coaster" and a seeding plow. The former came through an incident involving a silver dinner service ordered by Washington through his friend Gouverneur Morris, sojourning in Paris.

The set contained a wine cooler, then an essential factor of formal hospitality. The President worked out an idea for a holder akin to the old-fashioned castor used for condiments. He wrote that the castor outfit would be "more convenient for passing the bottles from one to another than the handling of each bottle separately, by which it often happens that one bottle moves, another stops, and all are in confusion."

The statesman-warrior-inventor thus described his device: "There should be two of them—one for each end of the table; with flat bottom, with or without feet, open at the sides, but with a raised rim, as castor stands have, and an upright by way of handle in the middle."

The first public try-out of the Washington coaster took place at a state dinner at which diplomats and other distinguished guests hailed the presidential contribution to the comfort of dining, which became the vogue in fashionable circles. The name "coaster" came from the fact that each basket had a roller which made it easily moved along the surface of the table.

Although Washington could be regarded today as a gentle man-farmer, he spent much time in devising inventions for farm uses. In his diary for March 26, 1760, we read:

"SPENT the day in making a new plow of my own invention."

Further entries read:

"March 27. Set plow to work and found she answered very well in the lower pasture."

"April 6. Made another plow, the same as my former, except that it has two eyes and the other one."

In 1786 Washington made and used a "barrel plow" for sowing grain. This device had "a spiked roller with the harrow at the tale over it, which I found very efficacious in breaking the clods and pulverizing the earth." The twelve holes of the plow discharged the grain too rapidly. By plugging all but four holes he finally made it work.

Neither Washington nor Jefferson made

any money from his inventions. It was beneath the dignity of a gentleman, Jefferson wrote, to take money for the product of his brain and hands. Benjamin Franklin, not regarding himself as a gentleman, nor so accepted by the standards of his day, did not hesitate to turn his many inventions to practical and commercial account.

The Franklin stove, a cast-iron fireplace which can be set up in any part of a

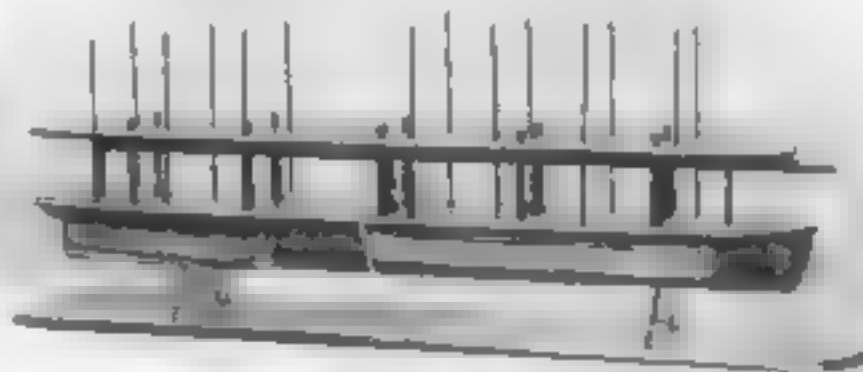


Folding writing desk invented by Thomas Jefferson, who thought a gentleman should not profit by it

room and connected with the chimney by a pipe, was the first step toward modern heating systems. It was the first heating device, in fact, in which most of the heat did not go up the chimney; in many old houses in Philadelphia, Baltimore, Richmond and other cities with a Colonial background, these stoves are still used.

On Franklin's copper plate press he printed the first paper money used in New Jersey. He invented a mangle for pressing linen and a clock that showed hours, minutes and seconds on three revolving wheels. Another gift of his genius was a mechanical arm for taking books down from high shelves. He first made spectacles with double lenses for reading and distance and suggested many improvements for air pumps, guns and carriage wheels.

The Rev. Dr. Eliphalet Nott, head of



Model in the U. S. Patent Office of the model of Lincoln's buoy to float Mississippi River steamboats off bars. The device was never put into use

Union College, Schenectady, from 1804 to 1866, invented the first stove for burning anthracite, and secured patents on this and other heating apparatus, from which he accumulated a large fortune without interrupting his educational work. On his inventions the great stove manufacturing industry of Troy was based.

Dr. Nott's wood stove, for the rooms

of students, was known from its peculiar shape as "The Coffin." His most picturesque invention was a "Three-Wheeled Chariot," an improvement on the "One Horse Shay." The body was supported by a rear axle on two wheels, while the third wheel, in front, turned with the shafts, enabling short turns to be made. With the student body of Union College there was a tradition that Dr. Nott was translated, like Elijah, and that the Three-Wheeled Chariot was the agency of translation!

Among American men of letters the late Samuel L. Clemens stands among the very first in the affection of the reading public, but few know that Mark Twain was an amateur inventor and that one, at least, of his inventions made money for him—though he lost more money on another man's invention. He financed an inventor named Paige who was trying to make a typesetting machine. Mark Twain's own early experiences as a printer interested him in this problem. But before Paige's machine reached the commercial stage, Ottmar Mergenthaler's type slug casting machine, the linotype, was on the market, and all of Clemens' investment was lost. He wrote to the publisher of a book intended to aid inventors: "If your book tells how to exterminate inventors, send me nine editions!"

THREE patents were issued to Mark Twain himself, however. The first, No. 121,092, issued December 19, 1871, was for an adjustable and detachable strap for the backs of waistcoats and trousers; the tabs to which the buckle was attached buttoned to the garments. But a tailor who had made a similar device proved priority of invention and Clemens' patent was declared void by the Patent Office.

Then, in 1873, Clemens took out patent No. 140,945 for "Mark Twain's self-pasting scrapbook," which can still be bought in stationery shops. Its pages are gummed and need only be moistened to make clippings adhere to them. Hunting for the paste pot was always too much of a task for the indolent Mark! His third invention was a game to help the players remember history dates, patented in 1893.

Few names are better known than that of Cornelius Vanderbilt, but few realize that three out of the four Americans who have borne it were inventors. The first Cornelius Vanderbilt, who began as a farm boy on Staten Island and established the first ferry service between that island and Manhattan, became captain, then owner, of the first steamboat to navigate New York Bay and the Raritan River to New Brunswick. Then he began to build steamboats from his own design, and the first successful seagoing steamships embodied many of his inventions in hull construction, as did the floating palaces he operated later on the Hudson River.

His grandson, second of the name, was not of an inventive turn, but the great grandson, the family's present head, General Cornelius

(Continued on page 136)

Making Money out of Scraps

Tremendous Waste, Which Would Pay Taxes and Buy All Cars and Houses in America Every Year, Is Reduced by Working Over Cast-Off Goods—Even a New Woolen Suit Is Partly Old

By ROBERT E. MARTIN

HERBERT HOOVER recently warned Americans that unless we eliminate much of our waste we cannot expect to maintain our present standards of living and high wages. Hoover's committee of engineers figures that by eliminating waste we can save ten billion dollars a year—which will be enough to pay all our taxes and buy all the motor cars, gasoline, and houses in the country!

"It doesn't look as if we're getting very far along that line," I remarked to a chemist.

"I'll admit we have a long way to go," he replied. "Still, I wonder if you know how many of your personal belongings and household necessities are made of the kind of things your father and grandfather threw away? Right now I'd like to have every dollar you've saved in the last year by using waste or reclaimed materials. Did you know that the woolen suit you're wearing probably has 10 per cent of used wool reworked into it? I wouldn't be surprised if some of the wool had clothed fifty men before you. Sheep's wool virtually never wears out. That's why the old-clothes man makes a living. A woolen suit would be a real luxury today if old wool were not reclaimed and worked in with the new."

THAT was the beginning, for me, of a revelation of the lengths science, like a thrifty housewife, has gone in reclaiming waste.

I learned, for instance, that most of the textile dyes were once waste from coal in gas plants until chemists learned how to remove the tar from coal and from it extract useful by-products. Today they have turned fully five thousand of these by-products into articles of value, including medicines, disinfectants, perfumes, flavorings, moth balls, creosote and road dressings.

Incidentally, another coal cast-off from the gas plants, ammonia, saves much of the cost of food for my family. Ammonia almost drove the gas engineers mad until some one discovered that it was an excellent fertilizer. Now it is con-



A unit department store where buyers, teachers, nurses and housewives can select from a great variety of materials as they go along which serves as well as the most important and reduces the cost of production.

See right-hand side of page 39. Made deep near in his pile of scrap, which he has gathered over his castings for lamps, ranges, broilers and other goods.



One of the 170 war-time ships dismantled by the Ford plant in the last stages of destruction. Every part of the vessels, even nails and screws, was used for some purpose.

verted or almost so, not the least of which is less refrigeration. This not only helps to grow more food, but aids transportation and storage, reducing the cost of food accordingly.

You'd be surprised to know how many foods for your table are made by using by-products in some way or other," the chemist explained.

Take cooking fats, vegetable oils and shortenings, for example. Many are made from corn and cottonseed. During the war Germany col-



lected grease, reclaimed it and used it for food. They also extracted oil from pumpkin and other seeds, fruit stones, and even orange and lemon pits. One city thus obtained 800,000 pounds of oil in a year. In normal times, of course, the cost of collection is too high, but knowing how is worth something. Even now chemists are making a very digestible oil from tomato seeds, the left-overs from catsup factories. And it is also being used for fuel, soap making, and even in varnishes! In much the same way they're turning refuse from cider-making and other fruit wastes into a jelling agent which, as your wife will testify, helps a lot in making syrups, jams and jellies. From vast piles of fruit pits, the California fruit industries have obtained millions of pounds of high-grade charcoal, as well as valuable oils.

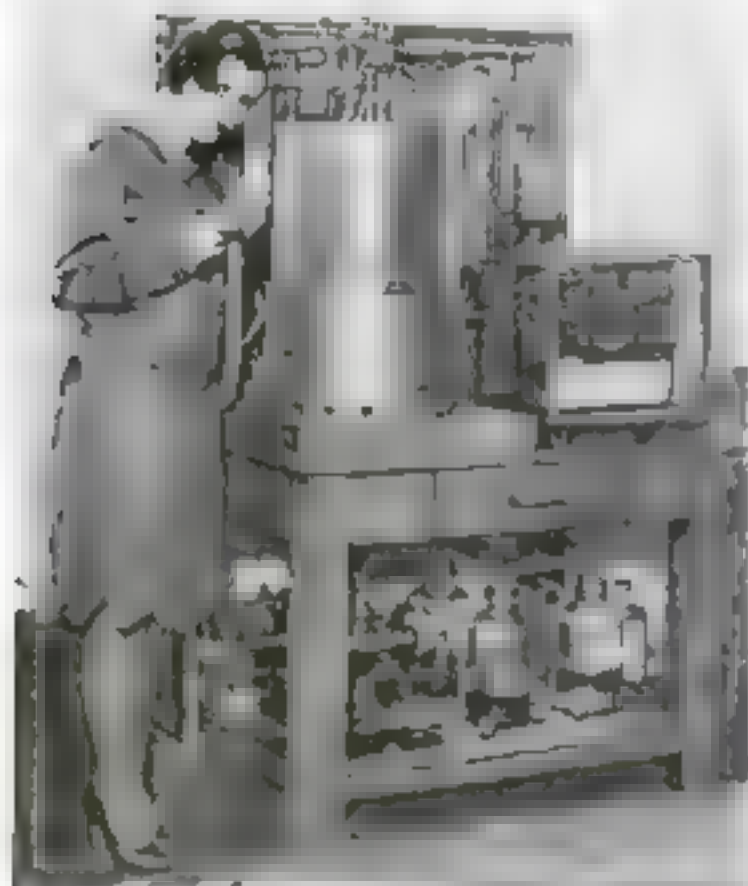
Much radio apparatus is built of waste. The glossy composition panel, the dials, knobs, binding posts and other small parts are made from phenol, another tar waste, mixed with formaldehyde, distilled from wood waste. The metals in the radio instruments, as well as the felt pad under the cabinet, contain reworked

(Continued on page 103)

Science Discloses New Secrets



The results of that patient's treatment, announced by Dr. James W. ... for ... was right ... Mrs. Gar ... says Doctor ... reveals a ... of gray matter that is only equaled, but not exceeded by the best brains in the Cornell collection. It definitely substantiates her ... that, given the ...



Fourteen ... in the New ... New Jersey ... New York ... Hudson ... Bureau of Mines ... air contains 4 parts in 10,000 of the gas ... blowing ...

A year's ... Bureau of Standards ... super ... the sun ... Bureau ... weather ...



suffering from pernicious anemia, the ... which halts the building of red blood cells in the body.

Some three years ago the discovery was ... by chance, that beef and cod liver ... mysterious element capable of ... this blood building process. Phosphorus found difficulty, however, in persuading patients to eat a half pound of liver daily. The result was the new pow ... containing the vital curative elements ... Ever without the actual tissue. It is the product of experiments by Dr. Cyrus C. Sturges, director of the Thomas Henry ... Medical Research ...

... found that there's more truth than fancy in the ... "red blooded" as applied to persons ...

... J. B. S. Huxley ... though it may shorten a life, will also ...

Race Determined By Hair's Weight

GIVEN a few hairs and the Sherlock Holmes of modern science may tell the race and, most likely, the sex of the individual from whose head the hairs came.

This novel means of identification, developed by Dr. Morris Bernstein and Sylvan Robertson of the University of Chicago, is based on the comparative weight of human hairs. Taking ten pieces of hair two inches long from people of different races, the experimenters weighed them on delicate balances. They found that Chinese and Japanese have the heaviest hairs of all—sixty percent heavier than those of the white race. The latter, in turn, are sixty percent heavier than those of negroes. The black-haired people of southern Europe have heavier hairs than the blond races of northern Europe, while masculine locks are eighteen percent heavier than feminine.

Developments and advances in various scientific fields that bear importantly on the affairs of everyday life are recorded each month in these pages.

Woman's Brain Vindicated

DURING her life Mrs. Helen Gardener, author, lecturer and champion of women's rights, contended that women were in no way inferior to men in mental capacity. To prove her point she bequeathed her brain, when she died in 1925, to the Bart G. Wilder brain collection at Cornell University. There it was compared with the brains of twenty other men and women, including doctors, lawyers, professors and naturalists.

Decay of Rubber Checked

AS EVERYONE knows, a tire or any other article made of rubber deteriorates very rapidly even when not in use, due to oxidation caused by the oxygen in the air.

To combat this decay chemists of E. I. du Pont de Nemours and Company recently have developed a new product for treating rubber goods. Tests promise that it will greatly prolong their life. The new enemy of oxidation is called neozene.

High Blood Pressure's Merit

A POUND of liver condensed into five tiny vials full of powder is the newest discovery for restoring vitality to persons



The ramie plant, the skin of whose stalk yields a fiber that is called a satisfactory and cheap substitute for cotton and, in some respects, superior to cotton, is being developed in Pasadena, Calif., by George W. Wilson, who is shown in the photograph with a seed bed of the remarkable plants.



In a laboratory of the U. S. Bureau of Standards, Washington, Dr. Paul R. Heyl has spent years weighing the earth and will spend more before the task is finished. Deep enough to avoid surface effects, he measures the action of gravity on a pendulum in a box and from this calculates the weight.

What Makes Your Heart Beat?

WHAT is it that makes your heart keep on beating seventy or eighty times a minute, year after year, throughout your life? Of many explanations offered, the latest comes from a noted Dutch physiologist, Dr. H. Zwaardemaker of the University of Utrecht. He advances the remarkable theory that the mysterious energy is none other than radioactivity, like radiations of radium.

The heart is kept in motion, he asserts, by rays from the chemical element potassium, which is believed to be freely radioactive and which is known to be present in the blood and heart substance.

In experiments Dr. Zwaardemaker claims to have discovered that the heart muscles, removed from an animal, can be kept in motion by rays from radium and other radioactive substances.

Dog Understands 300 Words

AN UNUSUAL dog took intelligence tests at Columbia University the other day, and convinced psychologists that animals of his kind possess more brains than most men suppose.

The subject was Fellow, a highly pedigreed German shepherd dog owned and

educated by Jacob Herbert, of Detroit, Mich. Five years old, he showed the apparent intelligence of a child of eight. In four years, according to his master, he has learned the meaning of 300 words.

For an hour Fellow astonished the class of Professor C. J. Warden, head of the Animal Psychology Laboratory at Columbia. He obeyed a wide variety of instructions, such as:

"Go to the table, Fellow. Put your head on it. Put one foot and your head on it. Now you can jump on the table. Sit down all the way. Now stand up. Look out the window. Turn your head the other way. Go over to the lady in the corner. Put your head in her lap. Now, suppose you go to the front door."

Professor Warden and Dr. Lucien N. Warner, animal psychologist of New York University, doubt whether the dog understands words in the human sense. Professor Warden said, "It is easily possible for an animal to obey commands and words not as words but as sounds."

Movies of Airplane's Wake

CAN you imagine a movie camera working so fast that it would take twenty minutes to view on the screen all the pictures it photographed in one second?

Such a camera has just been brought to the United States by Baron C. Shiba, head of the Aeronautical Research Institute of Japan. It promises to be of tremendous value in studying and improving the design of airplanes; for the camera is so fast that it actually can photograph swirling currents of air!

The instrument has been designed especially to study the eddies and currents set up in the air by a speeding plane or by the blades of its propeller.

Ordinarily such air currents, moving at tremendous speeds, cannot be observed. Baron Shiba's camera, however, is able to record them by taking 20,000 successive pictures each second. This is twice as fast as any previous camera.

Do Stars Flash Electricity?

THE flash of light you see when a star shoots across the night sky may not be caused by heat, as has been generally believed, but by electric sparks.

Dr. Pietro Burgatti, of the University of Bologna, has just completed a study of this light, and concludes that it is due to electricity developed by friction when particles of matter, hurtling through space at enormous speeds, encounter our atmosphere. It is like the electric sparks that appear when you stroke a cat.

If this is so, astronomers must revise their theory that the light results when these visitors from outer space are heated by friction and burst into flames.

Magnet Lifts 30 Times Weight

A NEW steel alloy which possesses amazing powers of magnetization is the recent discovery of Dr. P. H. Brace, research engineer of the Westinghouse Electric and Manufacturing Company. It is cobalt steel alloyed with tungsten. In the form of a horseshoe magnet it will lift a bar thirty times its own weight!

In a recent demonstration, spectators were amazed to see a bar of the alloy floating in the air. The explanation lay in a similar bar placed beneath the floating one. The two bars, magnetized with like poles opposite, were held apart by the magnetic repulsion between them. And since this repulsion was greater than the force of gravity, the upper bar actually floated!



An ingenious device called the phono-audiometer tests the hearing of school children at Chelsea, Mass. A phonograph recites numbers with varying loudness. The pupils listen through earphones and write down the numbers they hear. The numbers detected indicate the acuteness of hearing.



No smile in Gil's eyes now. "I'm going to get—Jim—Wenden!"

Whirling Wheels

*A Romantic Novel of the Automobile Age—How
a Great Game of Skill and Ingenuity Was Won*

By

EDMUND M. LITTELL

Illustrated by B. J. Rosenmeyer

GIL repaid that note in full a year later, with a light in his eyes that was a fire, and a kind of a before-the-battle grin deepening the creases in his cheeks.

"Great day" was the way he led off. "I pay off my note on the day the Selden patents are quashed. Quite a combination, what? I told Jim Wenden sixteen years ago that the Selden patent was no good, a better man than I am told me. And it took Ford eight years to prove it in the courts—on the basis of the Brayton engine. Well—the game is free-for-all now. No strangle holds by anyone."

And he would have added, if his banker friend had not already known it, the second breath period in The Game was going on. A great year, 1911. The year before had seen the breaking away from the influence of the King of Belgium body; the whole crowd had begun to design "automobiles, not parade wagons," as Gil put it. The backward-flaring tonneau lines had disappeared; doors were being used, low in front, level with the body behind. Tops and windshields were being sold as part of the car, not as accessories. Left-hand steering had become standard, except for export jobs. The Society of Automotive Engineers had been formed, and was busy with the establishment of uniform standards for tires, steel, screw threads—everything that was used in The Game. And the Herrick Automobile Company—

It was twice as large as it had been four years before. The two-story front was now extended back on each side, making a U-shaped building. Its great central area, still one story in height and roofed with saw-toothed glass, was a forest of belts that led to machines packed in like sardines. Not a bit of machine work was being done outside the plant any more. The only units brought in complete were the electrical ones—magnetos, distributors, and dynamos. Even bodies and fenders were being made in the plant.

Instead of an endless parade of trucks with long-racked beds that plied endlessly between Herrick and the body plant, there were now carloads of sheet steel, full finished light gauge for bodies, and semi-finished heavier stock for fenders. The light stuff was hoisted upstairs; the heavy stuff stayed below where enormous hydraulic presses clamped down on it and turned it into fenders, front and rear, with one powerful bite. Upstairs there was a parade. At the far end of the wings skeletons of bodies took shape. They crawled toward the front on a conveyor in slow procession, and as they crawled they began to take on the sheet metal sides, upholstery, and paint. They crawled through the long, dark tunnels of ovens, and came out dry; they were sprayed with paint again. Tops were built and applied, and at the proper moment a completed body was set on a conveyor and lowered to meet its appointment with a

chassis that was moving down a line downstairs. Synchronization; timing—it was the materialization of G. W.'s dream. From mills and foundries and forests, through machine shop, assemblies and countless inspections and tests—it was the trickle and brook and creek and river that Gil had told about—with a 15,000-car production planned.

"But we're not done yet," Gil was adding, and the light in his eye was undimmed. "We've only just begun."

"I don't know," said Mr. Oliver H. Marston. "This thing's got to stop somewhere. There's bound to be a saturation point, you know."

"PISH! That's the banker talking, Mr. Marston. They've been saying that about us every year for years! There is no saturation point! Why, even the used car problem—it's quite a problem these days, but look: Every used car sold makes a prospect for a new one. No, sir; there is no saturation point!"

"Well, go ahead, my boy, go ahead. I can't complain, even if the whole business should vanish overnight. You've made a fortune for me, my boy—" his voice died and his eyes took on the dreamer's look. Memories . . . Then they narrowed and turned to look sharply at G. W. "Only begun?" he repeated suspiciously. "Just what do you mean by that statement, young man?"

He suspected, but asked for confirmation. And got it. For Gil stood up and leaned forward with the palms of his hands flattened on the glass that separated them. No smile in his eyes now; only a crystal-hard light. His lips made a thin line, and parted to let out words, metallic words, one by one, that dropped into the silence like timed bombs.

"I'm—going—to—get—Jim—Wenden!"

Mr. Oliver H. Marston had expected it, but even so, it took his breath away. The vindictiveness of it, the terrible deadliness! He leaned back, as though the hot glare from those blue-gray eyes were a living flame from which he must withdraw.

Then he stood up slowly, walked around his desk and laid a trembling hand upon the younger man's shoulder.

"Don't do it," he said. "Don't do it, my boy. It isn't—"

"Yes it is." Gil's lips closed like a trap. "It's going to be done."

"But why, Gilbert?" It was the first time he had ever used that name; it vibrated with the sincerity of a parent arguing with a stubborn child. "Why? Aren't you both getting along all right? Isn't there room for you both in this—"

"There is not!"

"Look what you've accomplished!" The banker's voice was pleading, his eyes as well. "See what a magnificent thing you've done!"

"Which couldn't have been done without your help, Mr. Marston; no one appreciates that any more than I do. But it's—"

"Then why do it, my boy? And you are my boy. I've come to feel that way about you, Gilbert. With that lovely wife of yours and those four splendid children—why, Mrs. Marston and I—we're getting old, Gilbert—"

"Bosh! Not a day older than—"

"We've come to the point where we enjoy having you at the house as much as though you were our very own, mother and I. And those children—we think of them as our grandchildren! Don't do it, boy!"

But Gil shook his head. His eyes may have softened somewhat, his "Bosh!" may have been a trifle husky, but—

"Do you realize what Jim Wenden has been doing to me all these years?"

"Yes, I do; and—"

"He has jeered, and tricked, and bragged, and boasted—at me! The very first thing he did, on the day we met, was to squeeze my hand in that calloused paw of his—and I can almost feel the pain of it now. Why did he do it? Simply because I happened to be taken—taken, mind you, without

any knowledge on my part!—to board at a house where they needed the money—and where his girl lived. His girl! Plague, plague, plague! Trying to make me mad so I would fight him, then he could crush me, as he did every other man in town! He made me mad—by insulting the girl he called his! And I fought!"

HIS right hand went up to his left shoulder and rubbed it; his eyes blazed again. A man's soul was being exposed—and Mr. Marston was incapable of interrupting.

"He whipped me—and I whipped him. Gad—my Gad!—told me she loved me. But was he satisfied? No! When she went to Boston with her mother—what did he do? Followed her, and filled her full of lies. About me! My wagon was no good; it would never run; I was a dreamer, crazy—oh, he gave me a hellish two years! Because he almost convinced her, she went away to Europe, for two years. That on top of blinding me out of a four!"

"That's all paid up."

"Is it? Insinuating evil things about 'unlicensed.' Is that paid for? I smashed him a good one then! But what does a fist in his face amount to?"



Dressed a little younger as usual, and with some gray over his temples, Jim gazed down at a slender G. W. with the same old quizzical look. "Well, well! Here we see again! Look out for me, Gil; I'm going after you!"

Trying to make trouble in my plant! Forcing me into a race! And Wally—"he stopped for a moment. "Do you know what Wally said to me before he— He said 'Go get him, boss! And I'm going to get him! No, Mr. Marston, I'm going to refuse your advice this time. I like you. Tremendously. You've come to take the place of a father to me since that day when'—a little gleam of humor appeared, his lips twitched—"when you came down the walk and ordered me off the place."

"My boy!"

"But this time—I'm going to get Jim Wendlen! As long as he has any power he'll do me harm; the only way to hurt him is to rob him of that power. I'll—"

"Harm? My dear boy, he has done you nothing but good! Can't you see—"

"Oh, I'm not going to play his dirty game! I'm not built that way anyway—" another twinkle—"I don't know how it's done. I'm going to whip him fair and square."

Here was the thing old Oliver H. Marston had feared. A young man to whom wisdom, even though it had been acquired in years of living, was not welcome. Refusing to see that enemies are sometimes friends because they make us mad and make us go to work. And Gil refused to accept that view!

BUT—he proposed to play fair, at least. Mr. Marston sighed, and the hand that had rested so supplicatingly on the slender shoulder slipped off, slowly, with a lingering drag that was a caress. A thin-skinned hand on which blue veins showed clearly. And Gil went on.

"I'll need your help," he said more quietly. "Lots of it. Not so much financial as moral. I'm going to put on a prize war that will clean him out; that's what I'm going to do. And that means lots of things. But I want to be able to come to you as I always have—may I?"

"My boy, if you came to live at our house all the time, nothing would please me better."

"Thanks, Mr.—Those kids of mine call you grandpa, do you mind if I just for once—I call you—"

"father?"

He reached out a slender hand and gripped the other with a mighty grip. Silently. Then he turned on his heel and left the office abruptly for a second time, while old Oliver H. Marston pulled out a huge linen handkerchief, blew a mighty blast—and chuckled.

"The infernal mot!" he said aloud to himself and his voice had the ring of affection, not of abuse. "The everlasting fool! Fighting!" Which might mean a number of things, but which to the venerable master of millions meant only one.

And that day began a battle of giants that was felt around the world!

For out in the plant of the Herrick Automobile Company a conference took place. There was Mac, whose grizzled hair was turning white but whose eyes blazed, there were red-headed Andrews and black-headed Morton and keen-faced Bob Legg seated about the long table with G. W. at its head. They were unchanged, those men almost the same in appearance as they had been when they first gathered about G. W. And why not? They were not old, the average age of the four was

not much over forty. The players of that Game were young, all of them. A young man's city, Detroit had become, its streets alive with the bustle and rush of Youth, the lobby of the Pontchartrain Hotel looked more like the meeting place of a football crowd than the headquarters of merchants of speed. Young.

"We're going after Jim Wendlen," said Gilbert W. Herrick. "We're going after him hard. He's had his innings, he's been the top dog long enough. We'll get him!"

ONE and all, they nodded. They knew; they had not fought through all the years without knowing. And they were ready.

And the fight will be fought right here in this plant," the boss of them all went on. "With you, Mac, in the shop; with you—Andy, you're going to have a circus under-selling that blow-hard!—with you, Moet and Legg—oh, what's the use? With all of us! Let's go!"

That was the word that crept out through the great plant. It

was as unconfined as air, that news; such a potent project could not have been withheld. Especially when it was soon made public by way of full-page advertisements announcing prize cuts all along the line.

There were many old-timers in that great plant. Two of them proudly claimed the distinction of still having numbers three and four on their pay roll cards. Many of them were department heads, many of them were superintendents—and all of them chuckled, and passed the word along. What can't a man

do with a force like that behind him? Force—that word means two things. In shop parlance it means employees, the pay roll, in another sense it means

vigor, active power, might. In the Herrick Automobile Company it meant both. The walls of the plant swelled with it.

It was apparent even up in those quiet rooms that were secluded from the rest—the laboratory and experimental rooms, especially in the

experimental room. Motors began to hum; silently, for they had perfected a muffler that merely sighed as it exhausted the machine gun explosions of high speed engines. The hum of gears, yes; the clicking of valve tappets as well, and

the whine of a dynamometer driven at all ranges with all kinds of resistances applied.

There was a four, cast en bloc, there were sixes, one of them en bloc, there were the beginnings of a V-type eight. All with cylinder bores tending smaller, for racing—both speedway and dynamometer—was calling for higher speed and greater efficiency. Contest committees were lowering the piston displacement maximum every year; they had to keep pace. There were all sorts of apparatus for the investigation of self-starting compressed air tanks with pumps to be attached to the motor, an auxiliary carburetor to be attached below the seat. Some optimistic inventor had conceived the idea of pumping a rich mixture into the cold cylinders and manipulating the spark lever in the hope of catching one cylinder at the explosion point. There were all kinds of mechanical devices with springs and pulleys and gadgets. And everything that went into the (Continued on page 108.)

NEXT MONTH

First installment of a thrilling new novel of the moving picture studios

"THE MOVIE MAKER"

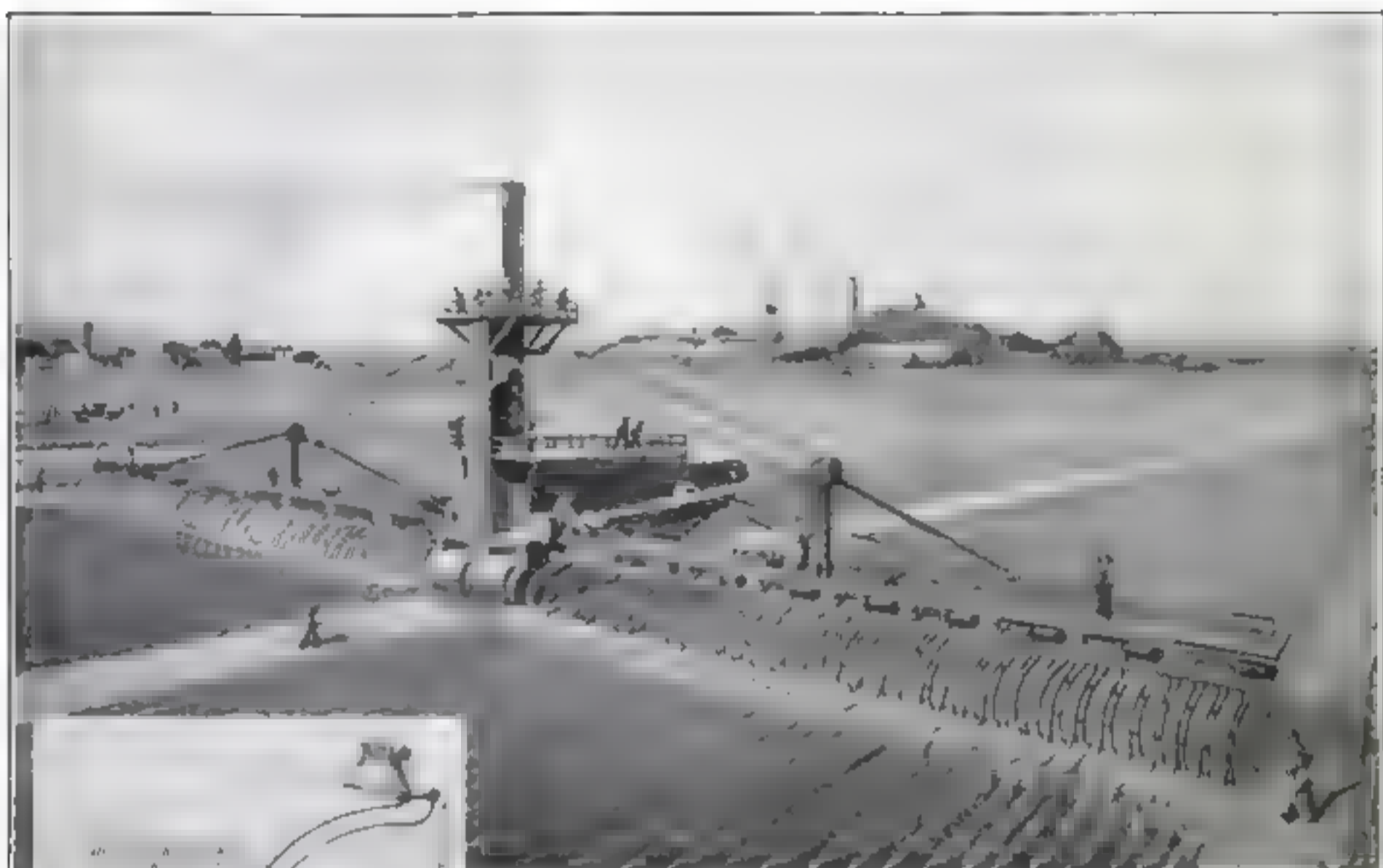
The tricks of the camera—the mechanical marvels of production—the secrets of the film laboratory—the new arts of lighting and make-up—every phase of the wonder industry of picture making discussed with fullest detail in a story of breathtaking interest.

Order the February POPULAR SCIENCE MONTHLY from your newsdealer now



Why hadn't he foreseen it? Gil sat with his feet on his desk for the rest of that afternoon.

A Plow 250 Feet Wide



The tractor of the future, plowing, harrowing and planting nine square miles a day

Machine of 6000 Horsepower with
Crew of Thirty-Six to Cultivate
and Plant Nine Square Miles Daily

ACROSS the field, advancing at a speed of ten to fifteen miles an hour, sweeps a monster of iron and steel. Smoke belches from its funnel. On a tower platform seventy-five feet above the ground stands its captain, shouting orders that loudspeakers relay to the crew of thirty-six men. By levers that operate great pulleys and cables, he manipulates long arms that span a swath of more than 250 feet. Now the mechanical monster has roared past, and where there was only smooth earth before, the entire field is plowed in deep furrows.

Far from an idle dream, this is a picture of what may take place on American farms in the very near future, according to Prof. Eric R. Lyon, of the Kansas State Agricultural College, who supplied the sketches and description from which our artist prepared the drawing of the tractor-plow that is shown above.

"This 400-ton giant," says Prof. Lyon, "is probably rather small as compared to some of the monsters that will be used in agriculture when the age of man-made dinosaurs fully arrives."

By large-scale farming methods with these machines, millions of men will be

released from farm labor for other useful work. Farmers will band together for coöperative use of such machines. In this way, Prof. Lyon's calculations convince him, their farms will yield new riches. Seven eighths of the farming population will be freed for other forms of production.

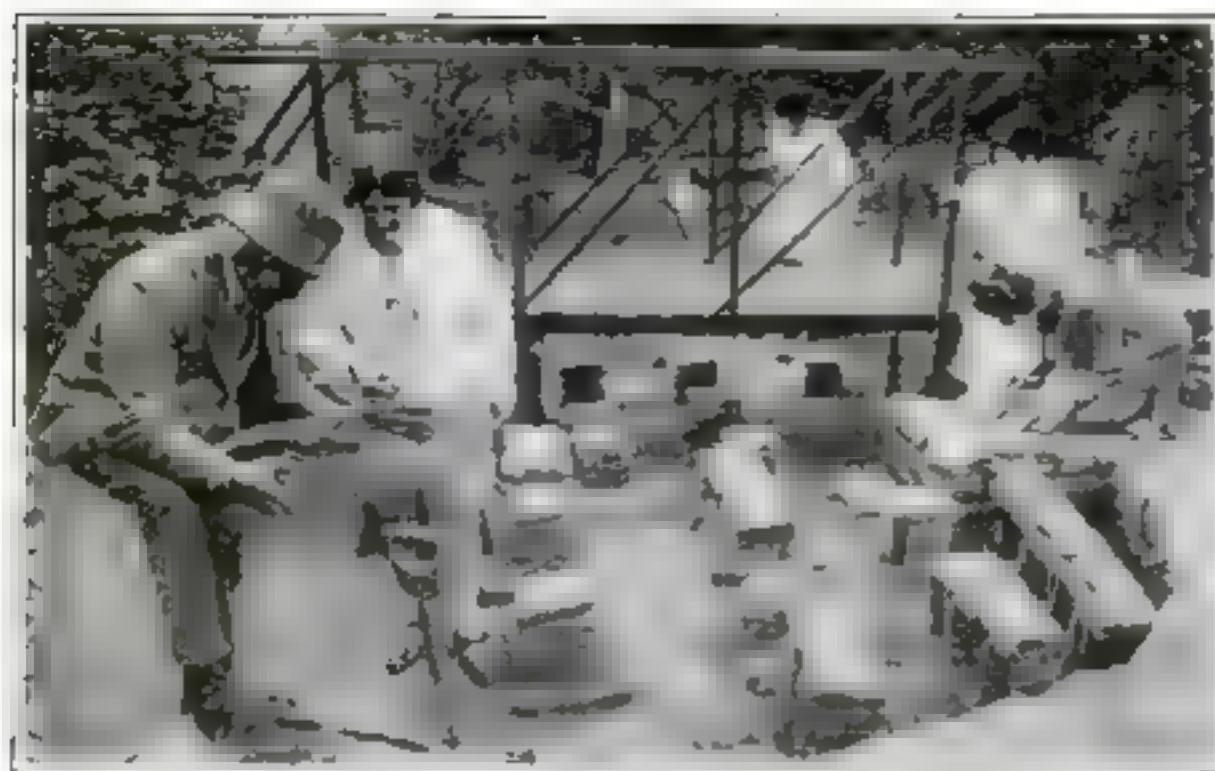
Such a machine as Prof. Lyon visions is a 6000-horsepower mammoth. One oil-electric and two steam-electric power plants will drive it, burning five tons of fuel an hour. At a speed of ten miles an hour, it exerts a hundred-ton pull—sufficient for the heaviest plowing combined with simultaneous harrowing, pulverizing and seeding. One such machine could farm two townships, or seventy-two square miles.

In use, the machine runs along a specially prepared thirty-foot roadway traversing the middle of the fields. Cultivator or plow arms hang in gangs from twelve-foot aprons on the underside of the immense bridge arms. Each apron has its own electric motor; an operator can instantly adjust the height of any gang, or raise it to clear a fence. This occurs automatically when an obstruction is encountered, by means of a metal pilot that closes an electric circuit. The opera-

tor on the bridge arm can shift a gang of cultivators sideways to center them on the rows. The machine can cultivate as many as seventy-three rows at once.

Although the giant tractor is conceived particularly to cultivate huge fields, it can be adapted to smaller ones through its ingenious mechanism. Telephone wires strung at fence height are easily straddled, but they are best carried in conduits under tractor roads. These roads will normally be 252 feet apart, the width of the tractor's span, but if necessarily nearer, the tractor can be run with only part of its tools lowered.

Working twenty hours a day, in two shifts, the giant tractor could easily cover more than nine square miles, or 5760 acres, daily—more than four acres a minute. It burns about five tons of coal an hour, or the equivalent in oil fuel. Crop operations would require, on a community plan, about sixty days out of the year. The giant would spend other time improving roads, leveling lands, running drainage ditches, and removing obstructions. It could also be utilized to fill gulches and deepen larger water courses, build levees, spread good soil on barren spots and recover washed-away soil.



Old Roman Furnace Found in English Garden

WHEN Owen Adams, of Havant, Hampshire, England, had bad luck with his apple and plum trees, he procured a spade and set to work to discover the reason. Beneath his orchard he found the remains of an ancient Roman furnace! In ancient Roman times such devices were used to heat elaborate baths and dwellings, with earthenware pipes to conduct heated air from the subterranean fire chamber. The invading Romans introduced the hypocaust, as it is technically named, in England. The illustration shows Adams and his daughter sifting earth for additional treasures, while others are searching amid the furnace tiles for further relics.

Muscles React to Light

LIGHT acts directly on the human muscles, and not through the nerves as has hitherto been held according to Dr. Lippay, head of the Physiological Institute of the University of Vienna. While experimenting in the effects of light rays on the nervous system, he observed that the muscles subjected to the rays underwent a contraction independent of the nerves. In further experiments he sensitized the muscles of a frog in a suitable solution and, excluding all heat radiation, exposed them to the light. In every case the muscles showed the same contraction. Within a short time Dr. Lippay expects to show more intricate influences of light on animal life.

Stock Ticker Must Speed Up

THROUGH the invention of some new kind of ticker that will print as many as 300 characters a minute, the New York Stock Exchange hopes to avoid such confusion as recently occurred when for nearly an hour shares of stock were changing hands at the wild rate of five million a day. The overworked tickers then in use throughout the city and beyond lagged twenty-two minutes behind the actual market. It was impossible to "trade from the ticker" as many speculators do, and many brokerage offices did not hear reports on their sales or purchases until an hour later.

These tickers were geared to print

about 300 characters a minute, recording by telegraph the transactions in the distant market. At that, they were forty percent slower than the devices of five years ago. But the present pace of trading requires more efficient instruments. The Stock Exchange and the New York Quotation Company are constantly working on the problem of increasing the efficiency of the ticker system. The best telegraphic engineers in America and in Europe are working on the problem.

Luminous Telescope Sights

LIKE a rifle, a powerful telescope may be quickly aimed at night by the invention of new illuminated "gun sights" developed by the General Electric Company and the U. S. Geodetic Survey. At the front and back of the telescope's barrel two quartz rod tips, made luminous by a concealed flashlight, serve as sights which speedily train the telescope on distant objects, such as the signal light fifty miles away used by the Survey. Due to its limited field of vision, the aiming of a powerful telescope at night has hitherto been a difficult and tedious operation.

Crime and Sun Spots

CRIME waves may be due to the influence of sun spots on individuals, in the opinion of Professor Alexander Tchajevski of the University of Moscow, who claims startling discoveries regarding the effects of the spots on human conduct. In a paper read recently he said:

The responsibility of a person in the commission of a crime decreases according to the nearness of the period of the sun spots' greatest activity to the time of the crime. Sun spots produce an enormous quantity of electrons that cause strong magnetic disturbances. These electrons also cause notable alterations in man's emotional and volitional centers, rendering him in a certain sense irresponsible for his actions."

New Zealand Opposes Burial Of Identity in "Australasia"

GEOPHIES must revise their nomenclature if the commercial interests of New Zealand succeed in a new movement to suppress the use of the term "Australasia." The New Zealanders are tired of being the tail to the kite of Australia, due to the use of the general geographic name applied to the island groups of the Pacific. The name "Australasia" was coined to indicate that the islands were an extension of Asia and that their central and most important division was the continent of Australia. In its restricted sense Australasia embraces Australia, New Zealand and Tasmania.

In a circular to foreign consular officers, the associated Chambers of Commerce of New Zealand says: "These offending terms both ignore our identity and submerge our individuality. Many people regard the words as descriptive of a greater Australia. We are separated from that country in ways other than the 1300 miles of ocean between us, and we want the world to know of the existence of New Zealand and that our identity is separate from that of Australia."

Hammer Lifts a Motor Car

WHEN an enterprising tool manufacturer recently sought to demonstrate the strength of one of his hammers, he bent an automobile from it! The spectacular test, designed to show that not even terrific weight could pull the hammer's head from the handle, proved successful, then the car was slowly lowered to the floor without injury.

To make the test as severe as possible, the hammer was hung from a crane hook by a clamp that grasped its handle, while the ring that held the heavy steel messenger or hammer was attached to the platform with its heavy load was swung into the air by a power crane.



How the strength of a hammer was demonstrated by using it to lift a motor car. Detail picture shows how the clamps were fastened to the hammer in the experiment.

Why Furniture Weighs More In Summer Than in Winter

THE weight of furniture varies with the seasons, according to the U. S. Forest Service. No matter what kind of wood has been used and how it has been seasoned and finished, the wood takes in and gives out moisture with changes in atmospheric humidity. This is the thing that causes shrinkage and swelling.

On a dresser weighing 200 pounds the change will be as great as twenty-four pounds. In temperature of seventy degrees dry heat from a furnace the moisture content is about three percent of the oven-dry weight of the piece as a whole. This is based on humidity of ten percent, as found in heated houses. At the same temperature and with seventy-five percent summer humidity, the wood may hold as much as fifteen percent of its weight in water, making a net change of twelve percent or twenty-four pounds.

Paint, varnish and enamel do not in the long run affect the moisture content. They check absorption and evaporation, and consequently prevent sudden swellings and shrinkage which place severe strain on furniture. They help, also, to prevent sudden moistening or drying of outside surfaces while inner parts are in opposite condition. For this reason it is important that the under surface of a table top should have the same finishing treatment as the upper surface.

All-Rubber Speedboat Built

ALL rubber, the first of its kind, is a remarkable speedboat that has recently proved successful in tests at Akron, O. It is made of hard rubber "lumber" which has a core of softer spongy material. Since this does not absorb water, as wood does, no boat-house is required.

Scaphus boats have also been built of the new experimental material, which is being tested by a great rubber company. It is probable that an all-rubber airplane will be built soon.

The Los Angeles contest of children's model airplanes. This photograph, taken from a motor car that towed the models, shows some of the little aircraft and their towing cords, swarms in gusts of wind results.

The special towing frame mounted on a motor car from which a plane model was being towed at one of the test fields in Los Angeles.



Huxley Skeptic on Feminism

THERE is little danger that "the women are going to run everything," So concludes Julian Huxley, scientist and grandson of the great Huxley. We are not headed even for full sex equality, he says, basing his view on anthropological research and modern biology.

"I venture to prophesy," he says, "not only that the inherent differences between the sexes will not tend to diminish in the course of evolution, but that man will continue as in the past, to emphasize them by custom and convention."

To the question "Which are brighter, men or women?" Huxley answers, "Both." The physical brain at birth is sexually neutral blank. In it certain secretions of the glands pick out and bring into action the nerve paths appropriate to men or women. A recent investigation in London schools shows "the intellectual differences between the sexes are very much slighter than popular belief allows."

Miniature Airplane Contest

MODEL airplanes, big and small, vied for prizes in a recent tournament at Los Angeles. Under the auspices of the city's playground association, their youthful makers saw the models tested for airworthiness by towing them from a special frame at the back of a moving automobile. Later they flew under their own power. Some of the most remarkable performances of flight and weight-lifting ability.

William Atwood, high school youth of Riverside, Calif., outdistanced all competitors by winning two cups and ten blue ribbons. One of his rubber-motored craft set an endurance mark of forty-four seconds in the air, a clockwork-driven plane flew for thirty-seven seconds.

"The cellars and the garrets where children make their toy planes," said Assistant Secretary of War Davidson recently, "are as important in their way as the huge plants where real planes are made. Air-minded childhood today means an air-minded public tomorrow."

A 15-Mile Butterfly Swarm

GAME wardens of the Cascade Mountains, in the State of Washington, reported seeing last autumn a huge cloud of flying butterflies ten or fifteen miles long and three or four miles wide. From their description of a few that descended, it is probable that these were the brown, black marked "milkweed" butterflies seen about the juicy plant all over the country. They are known to migrate southward in huge swarms to pass the winter. Many kinds of birds prey on them in their mass flight, catching them in the air.

"Hare's" Camera Films Dogs

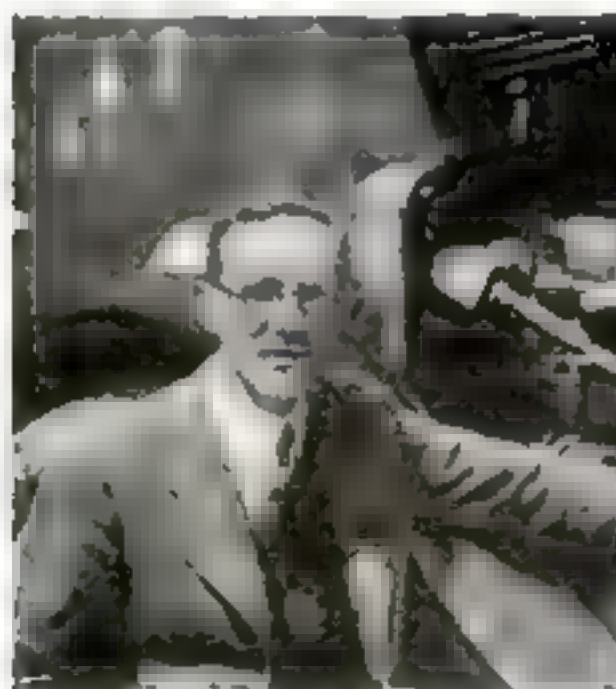
SLOW motion pictures of racing greyhounds, taken as they pursue an "electric hare," are made by a new British type of gyro-balanced camera. Clockwork drives it and the camera is attached to the body of the hare.

This remarkable "animal"—an imitation rabbit propelled around a race track—is used widely in England, where greyhound racing is popular, to make the dogs chasing it to great bursts of speed. Remarkable photographs of the dogs in action are expected of the new camera.



Made of rubber "lumber" with a spongy inside, the latest speedboat finds its lightness an asset. It skims on water and requires no housing. The Akron, O., owner never takes it from the water.

No Muscle, Just Touch of the Hand Steers This Car



C. W. Neiman, inventor of new steering amplifier, which makes steering of heavy cars as easy as turning a wheel.



The new steering

amplifier, said to magnify ten times the power of his touch on the wheel. It relieves the strain of driving by making the auto engine itself, instead of the driver's hands, apply the steering force. C. W. Neiman, a steel engineer, invented the novel device.

EVEN the frailest person, it is said, can maneuver a heavy car with ease through the aid of a new steering amplifier, said to magnify ten times the power of his touch on the wheel. It relieves the strain of driving by making the auto engine itself, instead of the driver's hands, apply the steering force. C. W. Neiman, a steel engineer, invented the novel device.

When the operator of the car commences to turn the steering wheel, a friction clutch immediately connects it to the motor. It revolves without additional effort, automatically stopping at the proper angle, as easily as if nine men were helping the driver steer! The driving mechanism, housed beneath the motor hood, can be disconnected to permit hand steering if the engine should fail.

An additional advantage is that there is virtually no loss of motion between the steering wheel and the road wheels, which are therefore instantaneously responsive. Not only can the driver alter the direction of his car with virtually no effort, but he can do so instantly. This is due to the fact that it is a follow-up type of clutch in which the steering wheel applies the friction. Again, the steering is not reversible and blows of the road or even a flat front tire would not wrench the wheel nor cause the driver to lose control of his car. The device, it is said, should be of especial advantage to women drivers.

Car Abolishes Gear Shifts

GEAR shifts are a thing of the past in a new car invented by a French engineer, it has no transmission gears at all, the motor's power being transmitted directly to the driving wheels at the rear. When Senoud de Levraud, the inventor, recently demonstrated his machine, it is said to have accelerated briskly up a twenty percent grade, stopped in the middle of the hill, and started again at the will of the driver to show that gears were unnecessary.

Jolts and shocks caused by clumsy gear shifting are dispensed with in this auto, and there is no danger of straining the motor as in an ordinary car by neglect to change to a lower gear on a hill. The need for lubricants, too, is reduced. De Levraud spent six years perfecting the car.

One-Speed Streets Planned

ONE-SPEED streets are part of a novel scheme proposed by A. D. Smith, chief constable of Glasgow, Scotland. He would set a definite rate for each of Glasgow's narrow streets, fast for some and slow for others, according to the type of traffic carried. By keeping separate the speeders and the laggards, he believes that the usual confusion would largely be eliminated. Such a plan might be applied with success to many American cities where overtaken streets are a problem.

Anti-Headlight Spectacles

SOON you may be able to drive at night undisturbed by the glare of oncoming headlights. A new kind of "specs," made especially to protect motorists' eyes from blazing lights, has been invented by Dr. Carl G. Bostrom, chief medical officer of the Swedish Navy. The spectacles are a clever combination of a German type of glass, greenish-yellow gray in color, that shades into clear glass at the bottom of the lenses. The upper part shields the eyes from irritation, the lower permits unobstructed vision on the road for driving.

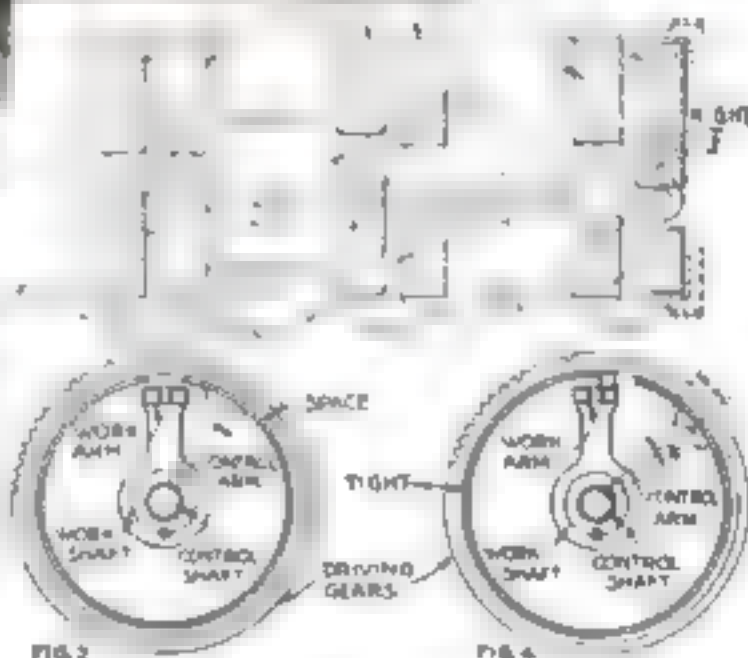


Fig. 1. Steering amplifier. Fig. 2. A section through Fig. 1. Fig. 3. Amplifier making left turn. Fig. 4. Making right turn. Fig. 4. How friction band engages drum.

Coast-to-Coast Runner Has Motor Convoy

SOMETIME in the near future, if his plans succeed, the young runner Levett will dash into New York with the first transcontinental endurance record. He expects to run the entire 3057 mile distance from Los Angeles, his starting point in sixty days. A motor convoy, carrying refreshments and sleeping accommodations, was built to accompany him on the long grind. Its cabin has a glassed-over roof with an adjustable cur-

tain. The truck carries spotlights to illuminate the road ahead at night.

Levett, who calls himself "the human dynamo," is backed by a group of business and professional men. He has no competitors, and his only goal is to establish an endurance mark. He has made many practice runs over the paved highways of Southern California, training for the transcontinental race, with his motor convoy rolling along beside him.



Levett, "human dynamo," who plans to run from Los Angeles to New York City in sixty days, taking a training run with the motor truck convoy that will supply food and sleeping quarters.

Engine and Electric Circuit Test Antiknocking Gasoline

HOW effective is an antiknock auto fuel? To test the ability of various blends as preventives of knocking, an Eastern gasoline firm has perfected a new type of testing machine. It consists principally of a one-cylinder engine that is run on the fuel being tested, an outside pin, piercing the cylinder head to rest on the piston, is so arranged that a normal explosion will jar it only slightly, but a distinct detonation or "knock" will cause the pin to bounce.

When a knock occurs, the bouncing pin closes an electric circuit for a moment; the passage of electricity is registered by the liberation of a small amount of gas, by the current, in a near-by liquid cell. After the engine has been run for a definite period, the total accumulation of gas is measured to indicate the amount of knocking. A sample antiknock fuel of already known characteristics is also tested in this way and used in the experiments as a standard for comparison.

Where Is Motor Cemetery?

IT'S easy to throw away your old hat, or your discarded cooking pots, but what is to be done with the car when it's worn out? Recently the New York State Bureau of Municipal Information asked 125 cities how they solved the problem. Suggestions ran from using the discarded automobiles as feds for river fronts and deep dumps to flattening them and leaving them on city dumps. One city, Norfolk, Va., covered the situation by the adoption of a special ordinance.

Harmless Block Halts Cars

SHOULD Chicago's motorists fail to halt their cars at "stop streets," established at dangerous crossings, a jolt from a new traffic signal, shown below, reminds them of their duty. Actually a thickness of rubber affixed to the pavement, it resembles a sheet of steel, and bears the word "Stop." Despite its formidable appearance, it bends flat beneath a car; a speeding driver, however, receives a jar. It also

shows just how far the motorist can go, when stopped by traffic signals, without obstructing pedestrians crossing the street in front of his car.

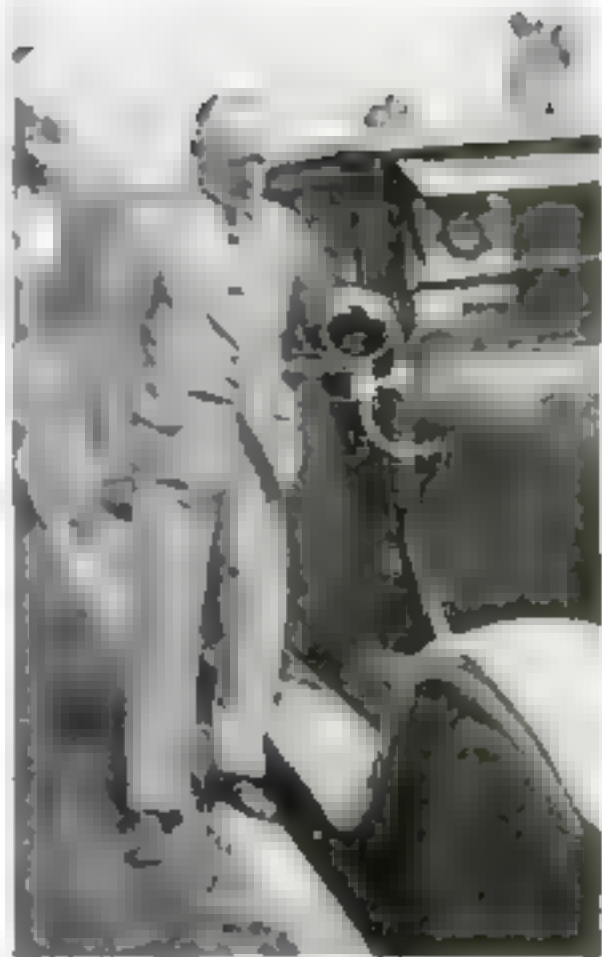
Rubber Tracks Improve New Caterpillar Tractor

RUBBER tracks for caterpillar tractors, experimented with for three years, are now being marketed. They enable a tractor to tread lightly and softly so as not to injure a paved highway, powerful traction, however, is said to be obtained by their use.

Separate rubber pads, about an inch and a half thick, are bolted to the endless track that revolves about the wheels. Their large width as compared with that of automobile tires makes wear a slow process, the tests showed. Their resiliency, meanwhile, cushions the entire machine and adds to the life of all working parts. The rubber track machines are also recommended for use within industrial plants.

Motor Mortalities Increase

A DEPARTMENT of Commerce survey of seven great cities shows 6993 persons killed by automobiles in the twelve months ended last August, or seven percent more of the total population than met a like fate the previous twelve months. The present yearly death rate is 217 for each million population.



Motor Light Pierces Fog

INTENSE colored beams of light from a new form of automobile lamp are said to pierce fog and reveal objects that ordinarily would be hidden by the white vapor. Particles of various metals, including gold, silver and platinum, deposited in minute quantities in the glass of the lens, produce the color fringes. Not only does the peculiar tinted light introduce a new system of fog penetration, the makers say, but much of the ordinary spotlight's blinding glare is also eliminated.

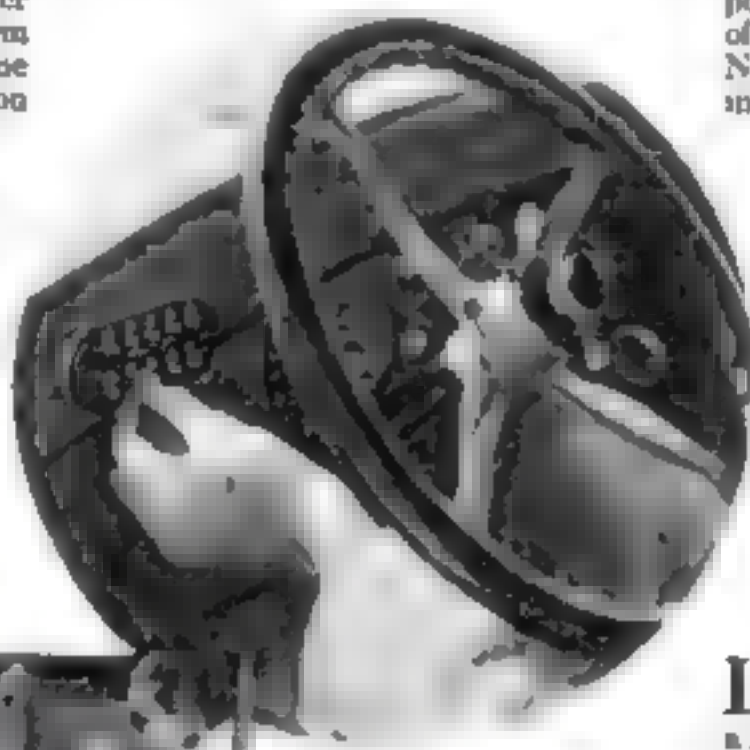
A special device built into the novel lamp permits it to be controlled from the driver's seat through a knob on the instrument board, and pointed in any desired direction. Through an automatic safety switch the light is extinguished when pointed at an angle that would blind an approaching motorist, and comes on again of its own accord.

Limiting Truck Speed

LATEST device to regulate the speed of motor trucks is the "monoblock," a French invention brought to the United States and recently demonstrated in New York City on a standard one-and-a-half-ton vehicle. Weighing only two and a half pounds with its cast aluminum inclosure, it is attached between the intake manifold and the carburetor of the truck's motor. With the monoblock in place, the truck can never exceed a certain speed.

Automatic governors have already been used on trucks to some extent in the United States. The new lightweight device is adjustable to any desired speed from, say, twelve to twenty miles an hour. It is said to prevent wear and tear on the motor by making sudden bursts of speed impossible, and by avoiding consequent fuel waste it is claimed to reduce gasoline consumption from fifteen to eighteen percent.

Several concerns using large numbers of trucks are considering adopting the monoblock for safety and economy.

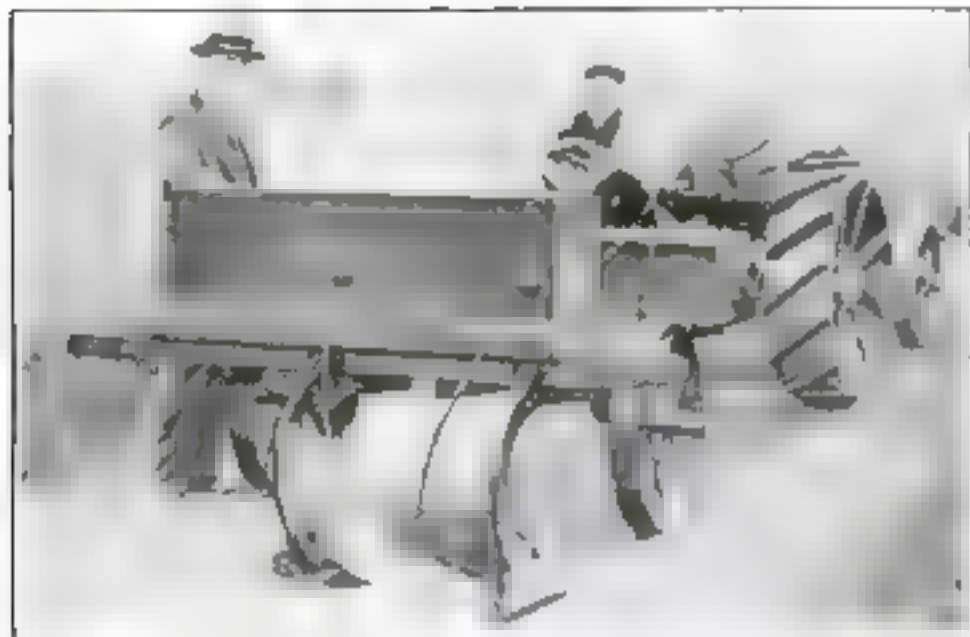


The Auto-Memory

TIME to change the oil or grease in your car? Compare the numbers of a new reminder dial with your speedometer reading, and it tells you in an instant. Whenever you stop for oil, look at your speedometer reading, add the number of miles the manufacturer recommends for oil changes, and set the upper row of your reminder to the new figure. The bottom row serves for progress. When the speedometer comes up to either figure, you need service.



At a dangerous crossing it looks like a solid steel sign to block the motorist if he does not heed it. Actually it is rubber. It yields if the car hits it, but it gives driver a jolt as a reminder.



How Electric Plow Wars Against Crop Pests

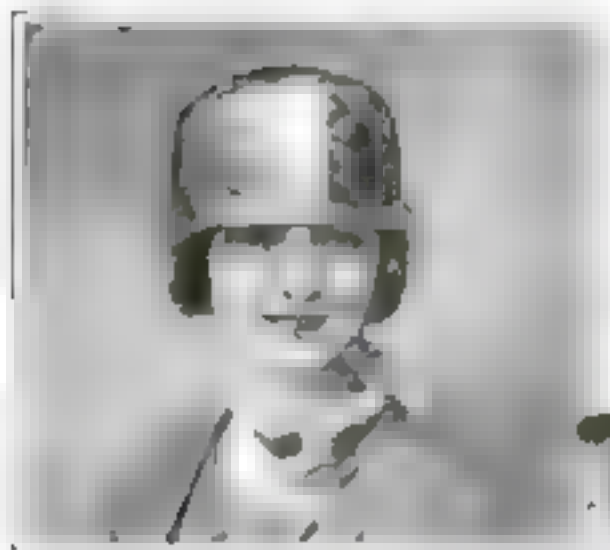
The wires of this plow, invented by H. L. Ross, of Pittsburgh, described in the November *Popular Science Monthly* flash 100,000 volts of current between the plow shares to kill all pests in the soil.

Curious Inventions



A Finger Ring Pencil

A pencil that can't be mislaid is that shown above. It is part of a ring that is worn on the index finger and consists of a diminutive lead-holder which can be refilled as required. The user writes as if with the finger itself. So small is the device that the wearer is said to be as unconscious of it as of an ordinary finger ring.



A Health Hat of Glass

The new glass that is said to admit the health giving ultra violet sun rays, now coming into use for windows, is also being applied into hats for women whose hair is an asset to be conserved. Martha Lober, actress, above, is wearing one of the hats.



Deadly Power of Rifle Increased

High Army staff officers and others witnessed recent tests of the new automatic rifle invented by J. D. Pedersen, pronounced the deadliest yet made.

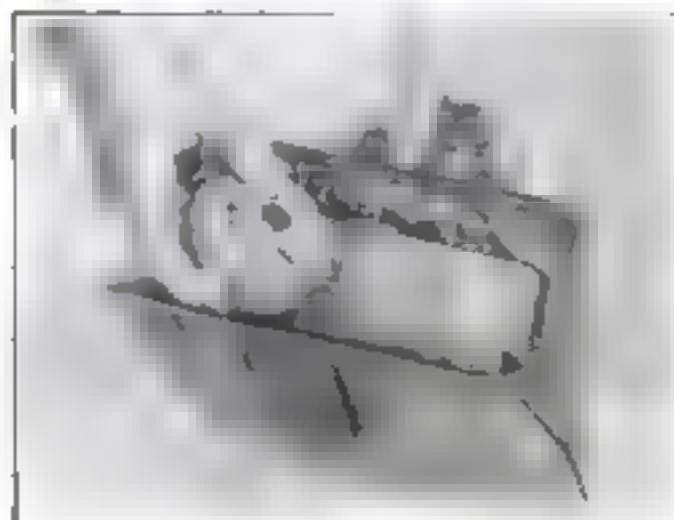
A Sailboat on Wheels

Like that of a real ship the muslin sail of the boat shown at the right is operated. She is steered with a standard sailboat tiller and the boom can be cleated on either side. Pedals will drive the craft if the wind dies down.



New Circular Padlock

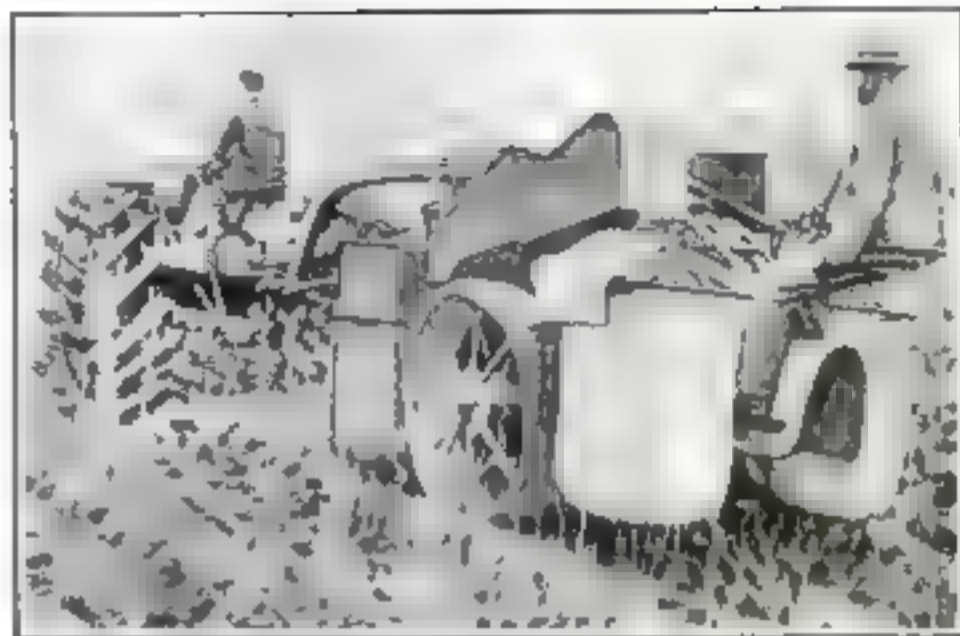
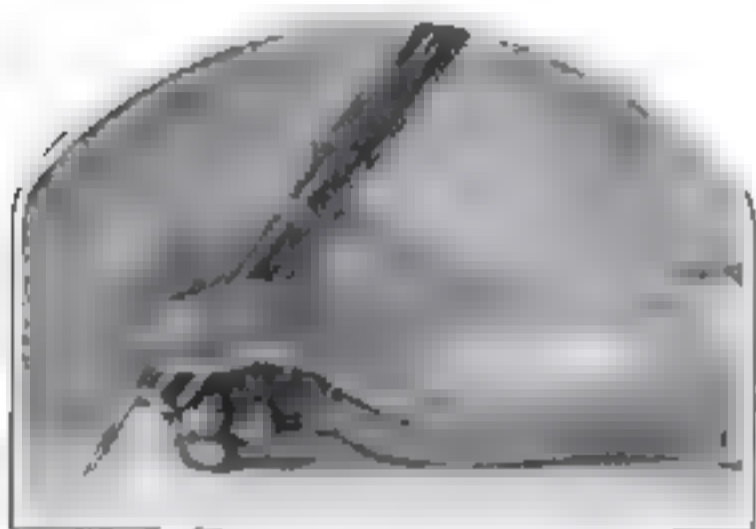
An improved padlock, shown at the left, consists of a ring that is locked into its container. When the key releases it you simply move the ring around until you reach a break in its circumference, when the device can be removed.



Hat Rain Shield Fits into Purse

Always ready for rain is the woman with this rubber hat cover that folds into a compact package.

Glass Hats to Aid Health; Sailboat That Has Wheels; Stopper for Stocking Runs; Many Other Useful Devices



Tractor-Drawn Machine Picks and Cleans Cotton

In fields where cotton has matured uniformly this new machine is said to pick effectively. Gathering shoes on the front hold the branches up for the picking spindles, which send them through the cleaner to the bags hung at the rear.

A Lighted Pencil

For writing at night the pencil shown above is mounted on a barrel which contains tiny batteries that cast light on the paper at the writing point. A cap protects the pencil and bulb when carried in your pocket.



New Telephone Is Ratchet-Proof

The transmitter of this telephone, invented in England for use in places full of the noise of machinery, is curved to fit snugly against your throat. When you speak, your words are transmitted, but the racket is excluded.



Punctures Defied

Kuno Schragin, inventor, is here from Germany with a pneumatic tire he says is puncture proof. It is of rubber with tiny chambers which naturally take in and expel air. Like a rubber sponge, through little holes in the tire's side.



Electric Boat for Children

An eight-foot boat run by storage batteries has an automobile starter. The motor is reversed to go forward or back.



First Aid for Silk Hosiery

Runs in silk stockings are said to be stopped the moment they are discovered by the device at the left, a stick of material resembling glue, which goes into a pore. Laundering ends its magic.

Finding Broken Light Wire

To find the break in an insulated electric wire, grip it with the pliers at the right. Their teeth, made of phonograph needles, respond except at the broken point.



Pressure May Make Diamonds

ONE of these days, in a device that exerts a pressure as terrific as would be the weight of a house upon your thumb-nail, chemists may succeed in making diamonds as fine as any you might buy at a jewelry store! Such a machine has just been invented by James Basset, a French engineer. Within the massive walls of its test chambers, sustained pressures reaching the tremendous magnitude of 500,000 pounds to the square inch—ten times greater than the blast of a naval cannon—are said to have been achieved!

WITH his apparatus perfected after exhaustive tests to ascertain the right steel to use and the best means of controlling the stupendous forces, Basset proposes to establish in France an "Institute of Ultrapressures" where chemists and engineers at last can find out how all kinds of substances and their atoms behave when squeezed beyond recognition.

Liquids, for instance, generally regarded as almost incompressible, undergo surprising changes. Petroleum was turned into a solid mass. Basset proved at 60,000 pounds to the square inch, and other fluids became either compact solids or very thick pastes.

Sensational discoveries in chemistry and crystallography may come on the heels of the new invention. Gases thought to be inert may react chemically, as did nitrogen when former investigators found that under high pressure they could make ammonia, a nitrogen-containing substance, from the air. The electric properties of atoms little known at high pressure, may be altered completely. Dr. P. W. Bridgman, at Harvard University, has done striking pioneer work in this fascinating field that is given a new tool in Basset's invention.

Even the synthetic manufacture of diamonds is a possibility. Already experimenters using the power of high explosives or the relentless pressure of cooling molten steel have succeeded in making diamonds a fiftieth of an inch in size. With the enormous sustained pressures now to be obtained and controlled in Basset's apparatus, science may at last imitate Nature's large scale methods.

NATURAL diamonds are believed to have been formed from ordinary carbon, familiar to you as the coal you burn or—in a slightly different state—as the "lead" in a pencil, perhaps by the terrific heat and pressure of volcanoes. Henri Moissan, eminent French chemist, sought to produce diamonds artificially by plunging an incandescent molten mass of iron and carbon into cold water. When the iron cooled from the outside in, it squeezed the still molten interior enough for Moissan, dissolving away the final lump with powerful acids, to find tiny diamonds.

Some blackish, others transparent. Sir Vaughan Crookes, noted English physicist, exploded charges of cordite in a closed steel cylinder containing carbon and also obtained minute diamonds. But neither experimenter could control his giant pressures, or hold them longer than a few moments at most.

At last this is made possible by the ingenious construction of Basset's "ultrapressure" pump, which works like a hydraulic jack. From a reservoir at the bottom, electrically pumped into the large bottom cylinder of the apparatus, where it forces upward a massive piston. The piston's top end is a slim

rod of hard steel sliding up into the close-fitting, slightly cone-shaped bore of a massive test chamber. Here the mighty pressures are thus generated.

"Ultrapressures" may be maintained for weeks at a time, for a special joint prevents the escape of the contents. Since no gage is made that could measure the pressure, a gage is connected only to the low pressure side of the apparatus, by proportion it indicates the far greater pressures existing above.

Extra test chambers containing chemical cables or electric furnaces are connected to the pump by special tubes of enormous and massive size, reinforced with hoops to prevent their expansion. Thus the pressures generated by the slim piston are communicated throughout the experiment vessels.

Basset's life was constantly endangered during the prolonged researches that resulted in the making of this device. Now and then a chamber would blow up and wreck havoc in the laboratory. Now, the inventor says, he has learned how to construct a device that is safe even under the gigantic pressures it creates.



James Basset and his ultrapressure apparatus. In the projecting test chamber and that set below it is pressure of ten naval gun blasts.



This pressure-bearing test chamber is connected to the pump by special tubes of enormous and massive size, reinforced with hoops to prevent their expansion.

Concrete Walls Smoothed Like Stone

MARKS of molding boards, and other surface irregularities, are whisked away from a concrete slab as by magic through the use of a new electric tool. The versatile device is equally useful to remove paint from brick walls, or to cut the back for the application of stucco.

In the head of the machine fits either a cutting tool, equipped with twenty-four toothed steel cutting wheels, or a disk of grinding material to smooth concrete surfaces. The apparatus is light, weighing only twenty-three pounds. It can be handled by a novice, its makers say.

Want Advice on Oil Burners?

SOME four thousand oil burner installations have been investigated thoroughly and from all angles by the Popular Science Institute of Standards. Advice based on the resultant findings will be gladly furnished free to readers.

Satisfactory answers are dependent however, upon adequate information regarding the conditions in which the burner is to be used. Inquirers must supply this information: (a) Number of rooms in house; (b) type of heating system; (c) annual coal consumption; and (d) is gas or electricity installed? Address Oil Burner Service, Popular Science Institute, 930 Fourth Ave., New York City.



Finishing a wall with the electric machine that cuts and polishes brick and concrete. Its head has interchangeable tools: one does the rough finishing, and the other polishes the surface.

Motorized Manicure Machine Saves Time



NOW you can have a fast motor-driven manicure! A machine with five different attachments—filing wheel, emery wheel, cuticle point, cotton point for cleaning under the nails and buffer of chamouis disks—is the invention of Mrs. Ida M. Eldridge, of Los Angeles. Metal guards protect the skin when the wheels are used.

Putting the finishing touches on a manicure with the buffer of the machine that operates all the instruments by electricity like a dentist's motor

Storage Battery Locomotive

A STORAGE battery that weighs thirty-two tons drives the largest electric locomotive in the world that runs under its own power. Capable of hauling a 1,500-ton train, the engine has just been placed in switching service in a railroad freight yard at Hammond, Ind. It is noiseless and smokeless in operation.

Novel Fireproof Wastebasket

NO WASTEBASKET fire can start from this new office receptacle. One of its metal sides swings open, by a convenient hand tab, to receive undreaded papers. When closed it is fireproof; even a burning match or cigarette within can cause no damage to office or furniture.



Not only good-looking but fireproof is a new metal wastebasket that is attached to the desk. Open it by the convenient handle to deposit waste paper; a spring closes it. No hot cigar ash can fall in; if it does the fire cannot escape.



Axles Made Four a Minute

STRONG but lightweight railway axles are brought nearer by the revolutionary idea of Charles G. Steele, a California inventor. He has perfected a machine that turns out hollow steel axles at the amazing rate of one every fifteen seconds. Railroad men who recently inspected his device pronounced it a success. Long research preceded the final demonstration, Steele says.

Metric Measure in U. S. Asked

SEVERAL million persons, in more than 100,000 petitions, have urged Congress to establish the metric system of weights and measures in the United States, according to the Metric Association. The General Federation of Women's Clubs also has called on Congress to scrap our present measures such as yards, rods, gills and pennyweights, and substitute instead such units as the meter or world yard, the half-kilo or world pound, and the liter or world quart.

Every civilized country but two, it is pointed out—England and the United States—uses the metric system, with its convenient units divided in tens and hundreds. Many manufacturers here oppose the change, calling attention to the expense of scrapping the old standards. Metric supporters reply that the substitution could be made gradually, and its expense largely paid for by the resulting increase in foreign trade.

Origin of Life Is a Riddle Yet Unsolved, Say Savants

SIXTEEN University of Chicago professors have issued a symposium summarizing recent extraordinary achievements of science. "But in all frankness," the book says, "it must be admitted that the problem of the origin of life has not been solved. At best we have nothing more than a series of preliminary hypotheses. The actual beginning of life remains an unsolved problem. The gap between earth materials and living matter has not yet been bridged."

"But," says Professor Rollin T. Chamberlin, "the study of geology does show that at a certain stage in the history of our globe the proper materials for the starting of life were brought together under conditions which then were peculiarly favorable for their interaction and the starting of processes leading to the functions of life."

Interesting is the description of one of our early ancestors, the *Ostracodermis*, meaning "the shell-skinned." These forerunners, earliest vertebrates of which fossils have been found, had neither jaws nor limbs. They had a natural protective covering of bone or other hard substance.

The conclusion of Eliot R. Downing, who writes on human inheritance, is: "The child starts where his parents started. A more favorable environment may help him progress faster and farther than they, but it does not, so far as we now know, change the nature of the germ plasma."

Head-Hunting Laid to Women

FOR the most part the influence of the Dyak women is on the side of head-hunting. They urge their husbands, sons and lovers to join in expeditions to prove they are really men of valor," says William O. Krohn in his new book, "In Borneo Jungles."

No Dyak, the author says, is a real man until he has got a head. So the young Dyak fortifies himself with an orgasmic dance, consults the omens, and salutes forth. When he brings home the head, there is a feast. The whole thing is a rite deeply interwoven in Dyak religion.

Another writer who blames the savagery of the savage upon the female of the species is C. W. Dornville-Fife, who reveals that in remote parts of the Sudan, Africa is still the Dark Continent. He nearly lost his life at the hands of seven-foot savages because of his desire to see a ritualistic dance marked by "the low jangle of necklaces, the beat of the tom-toms, and the wail of gut instruments."

Labor Saved by Machine Age

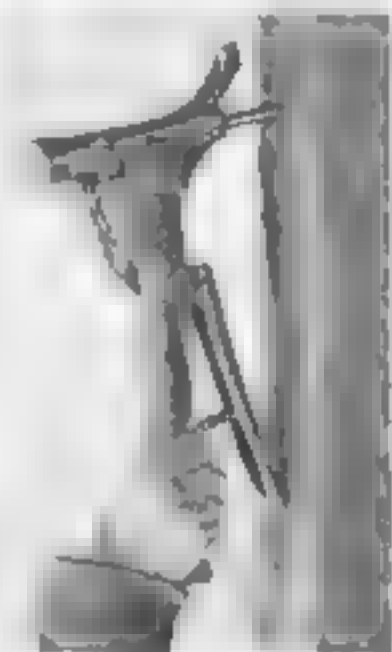
THROUGH the marvels of modern machinery, only sixty-seven men are now required, on the average, to do what was the work of a hundred twenty-five years ago, according to the National Industrial Conference Board. At this rate forty-five men will be doing the same work in 1950.

But machines have not thrown men out of work, because as production has increased, so has the demand for additional commodities.

Telegraph Pole "Medicine" Injected with Huge Needle

THE practice of giving logs a "hypodermic injection" to preserve them, invented in Germany not long ago, has spread to England, and a new tool has been invented to do the work. The new scientific method is being used to inject into telegraph poles a spreading paste that is said to keep fungi at bay. Many years are said to be added to the pole's life.

This treatment of wood is a step that may lead eventually to complete arrest of decay. If that ideal is accomplished, buildings of wood can be erected that will be as imperishable as structures of stone, brick or steel while the cost will be much less. The effect will be that of transmuting wood into rock.



The giant hypodermic spike injecting into an English telegraph pole a chemical that permeates the wood, delaying decay.

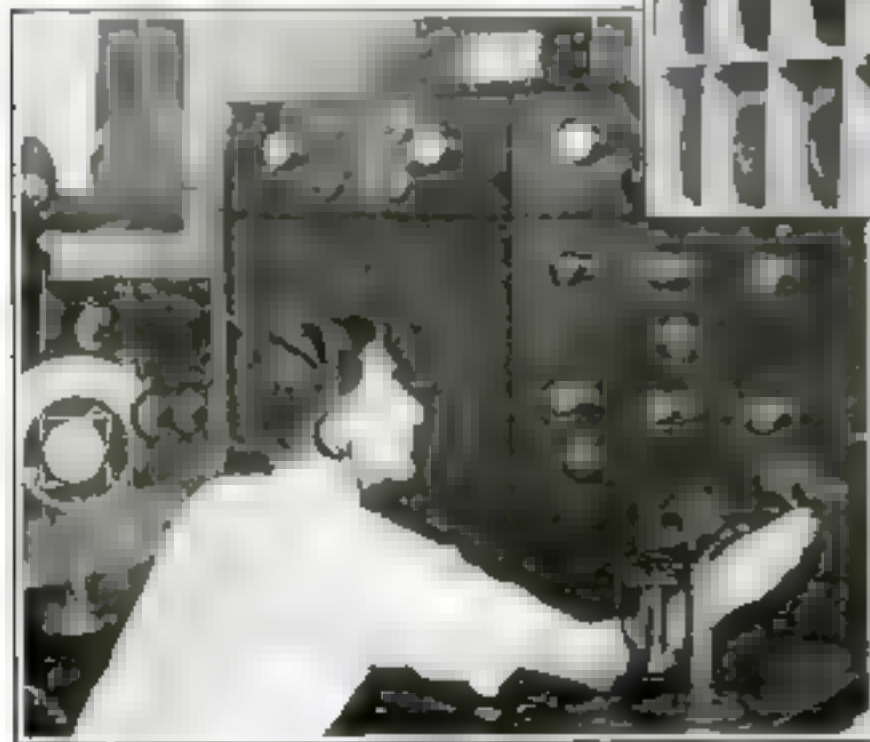
German Shipyards Come Back

GERMAN marine science and industry have come back since the war. German shipyards built 188,302 tons in 1925 for export to foreign owners, against the 139,047 tons built by British shipyards. In 1919 it was Germany, 28,578 and Great Britain, 487,102. Germany is now second in total tonnage built, with 490,700, Great Britain leading with 1,194,957.

The United States in 1919 built 216 ships totaling 803,389 tons, and in 1925, 120 ships totaling 207,884 tons.

Loudspeaker Weighs a Ton

ONE of the most remarkable loudspeakers, that of the largest in the world, stands atop a building that houses a Paterson, N. J., broadcasting station.



pictured below. Its twelve separate speakers, combining the effect of cones and horns, are united to sound with one mighty voice. Ten feet high, the entire speaker is powered by a 300-watt built-in amplifier; it weighs, altogether, more than a ton. Neighbor residents and passers-by near the building can hear in its loud tones the entire program that is being broadcast from the station.

Toy Balloon Spans Ocean

FROM New Jersey to Venezuela flew a toy balloon recently, and a South American chicken fancier picked it up. It had been released by A. O. H. Perry, of Hasbrouck Heights, N. J., who had attached a card bearing his name and address. He received word from the Venezuelan that the balloon had successfully crossed the sea to land in his back yard, scaring his poultry out of a year's growth. Thus a new transoceanic flight was written into the annals of recent aviation achievement.

Ready-Radioed Homes

WIRELESS aerials, lead-ins, and grounding switches were standard fixtures, the same as plumbing, provided in 300 houses that were recently built in Newport, England. The concern erected them as an added attraction for its homes, and by doing the work itself was able to see that they were installed uniformly.

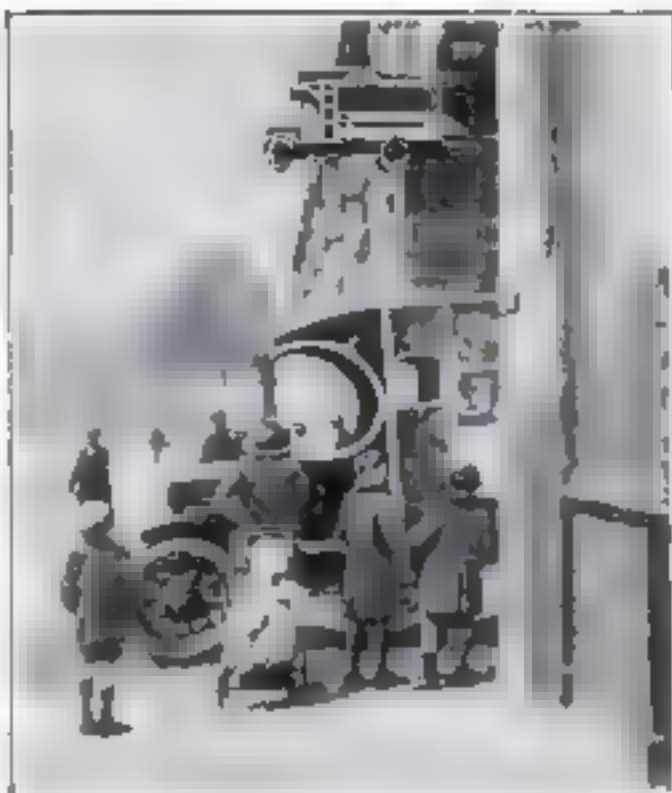
What Do You Want to Know?

POPULAR SCIENCE MONTHLY is glad, whenever possible, to answer readers' questions on technical or other problems within its scope. Queries should be addressed to Information Department, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York City.



Ten loudspeakers of the chorus of voices, some horn and some horn type, that fill the air with their voices, sounding as one at a New Jersey broadcasting station. The smallest speaker is ten feet high.

The great 300-watt amplifier that provides the volume for the twelve-in-one loudspeaker is Paterson, N. J. So great is the power of the voices in unison that broadcast programs are heard by a large portion of the city.



Tiny Car Warns of Big One

TO PROTECT pedestrians from cars that emerge from its driveway, a London firm of caterers has installed a novel warning signal. When a delivery truck is about to emerge a miniature of it appears on a sliding rod above the entrance. Passers-by see the toy car and stop, knowing the real one will follow.

Electricians of the firm invented the device, which operates automatically. After a car has left, the miniature rolls back out of sight.

Chases Flies 9200 Miles

THOU SANDS of flies, believed to include several kinds hitherto unknown to science, were recently brought back by Dr. J. M. Aldrich, entomologist of the Smithsonian Institution at Washington, after a 9200-mile tour of the Northwest. A study of these insects is declared important, since they are among man's most dangerous competitors for food.

Dr. Aldrich, who was collecting two-winged flies, technically known as the Diptera and including such well-known members as the housefly, tsetse fly, mosquito and gnat, found the Yellowstone National Park the best collecting ground he had ever explored. In another locality he found a few species of flies at chilly altitudes of 9300 feet. Although 55,000 kinds of flies have been described, Dr. Aldrich says there are probably 150,000 different species still unknown.

Grass Saves Coast from Sea

SAVING the coasts of England and Holland from the battering sea is the newest use discovered for an humble English pasture plant known as *Spartina townsendii*. It was named for the botanist Townsend, who saw its suitability for pasturage and its rapid growth. Recently, by accident, its coast-preserving qualities were learned, and British agricultural experts commenced to plant it systematically along shores that suffered most from the sea. The experiment proved a great success, and the rushlike plant is now used in Holland, too, to reclaim the shore front by rendering the soil firm against the eroding waves.



Police Club Traffic Light

IN THEIR attempt to solve the night traffic problem in Paris, authorities are trying out a remarkable new electric signal light built into a gendarme's club. It has two lamps, red and white, controlled by a switch. A battery on the officer's belt supplies the electricity.

Traffic posts spotted with lamp bulbs are another suggestion for motor control recently demonstrated in Paris. If it at dangerous intersections, they would guard against collisions.

At left: Traffic posts studded with lights which have recently been tried in Paris as one possible solution of the street accident problem. The various colored lights used are: S—Stop; G—Go; and other means of signals to automobile drivers.

Below: Another Paris innovation in traffic direction—a variety of red and white lights in the gendarme's club which he flashes on and off as signal instructions to motorists.



The World a Steam Engine?

THE heat imprisoned in the depths of the earth will supplant coal just as soon as some economical method can be found for drilling through the earth's crust to a sufficient depth and releasing it. That is the contention of John L. Hodgson, English engineer.

Hodgson would make two types of wells, one to the amazing depth of thirty miles, the second only five miles deep.

The heat in the earth is, he says, 31,000,000 times greater than that stored in all the coal known to be available. At a depth of thirty miles the temperature is 1000 degrees Fahrenheit. At that depth there are incandescent rocks. To raise enough steam to produce 4000 horsepower all that would be necessary would be to let a column of water fall on them.

The thirty-mile well need be only a foot wide. The steam from the well would be collected in a gigantic boiler.

For lower temperatures Hodgson proposes two vertical wells each five miles deep, interconnecting by horizontal passages of thirty miles each.

Hodgson's scheme for utilizing the earth heat for industry cannot be called entirely original. Italy has been doing this very thing at Lardarello, in Tuscany, and Italian scientists are at the present time studying means to utilize the vast stores of heat in Mount Vesuvius.

Roads of Tinted Concrete

GREEN concrete "which will harmonize with the rich semitropical verdure and growing crops" is the material of which Cameron County, Texas, plans to make its new six-million-dollar system of highways. On a smaller scale, colored concrete roads have already appeared in certain parts of the country; many of those built in parks and on private estates have been tinted.

Two-Story Motor Houseboat Tours at 50-Mile Speed

ALL the comforts of home while you travel are provided by a remarkable vehicle now under construction by a Rochester, England, air firm. Known as a "highway motor yacht," it has two stories; its capacious interior includes a lounge, bedroom for eight passengers, a bathroom complete with shower, and a glass-windowed observation chamber. Behind the driver is a kitchenette and bunks for the "crew" of three.

Six great pneumatic-tired wheels support the chassis, and a 110-horsepower engine drives it. The owner of this hotel on wheels, which will cost him between \$21,000 and \$30,000 to buy, will be able to tour anywhere at fifty miles an hour.

First World Crop Census

IN 1930, it is expected, the first world agricultural census in history will be completed under direction of the International Institute of Agriculture at Rome. This is the recent announcement of Leon M. Estabrook, director of the project and chairman of the U. S. Crop Reporting Board, who has visited every capital in Europe and North Africa to discuss the plan with government officials.

Only thirty-seven countries, representing less than half the area of the world, have taken a nationwide census of crops and livestock in the last twenty-five years. In many countries new government organizations must be formed to effect it; but all promise heartiest cooperation. Estabrook will next visit the Orient.

Light Gasoline for Planes

"NATURAL" gasoline, made from natural gas, recently proved its value as an aviation fuel. Tried in thirteen planes making a tour of the country, it increased the motors' speed with a fuel saving of more than three gal. an hour. Since it weighs considerably less than ordinary gasoline, the new motor fuel may prove important in distance flying, where every ounce of weight carried counts.

Mechanical Baseball Thrills

INDOOR baseball of a novel kind is played in a mechanical game recently invented by L. B. Elliott of San Francisco. Originally designed for disabled war veterans, it is rapidly growing in popularity. An entire contest, with all the variations and thrills of a real league game, can be played with the new device.

Balls are "pitched" by rolling them down a curved slide, while the opposing player tries to hit them with a miniature swiveled bat. He can score a hit or home run, depending on where the ball lands. If he misses the ball, and it hits the backstop, a strike is called against him.



The table baseball game, devised for disabled soldiers, which is gaining general popularity. L. B. Elliott, of San Francisco, the inventor is "pitching," rolling the ball down a curved slide, and "Lefty" O'Doul, a professional ball player, operates the mechanical player with a bat on a swivel.

Bicycle Pedals Drive Novel Plane's Wings

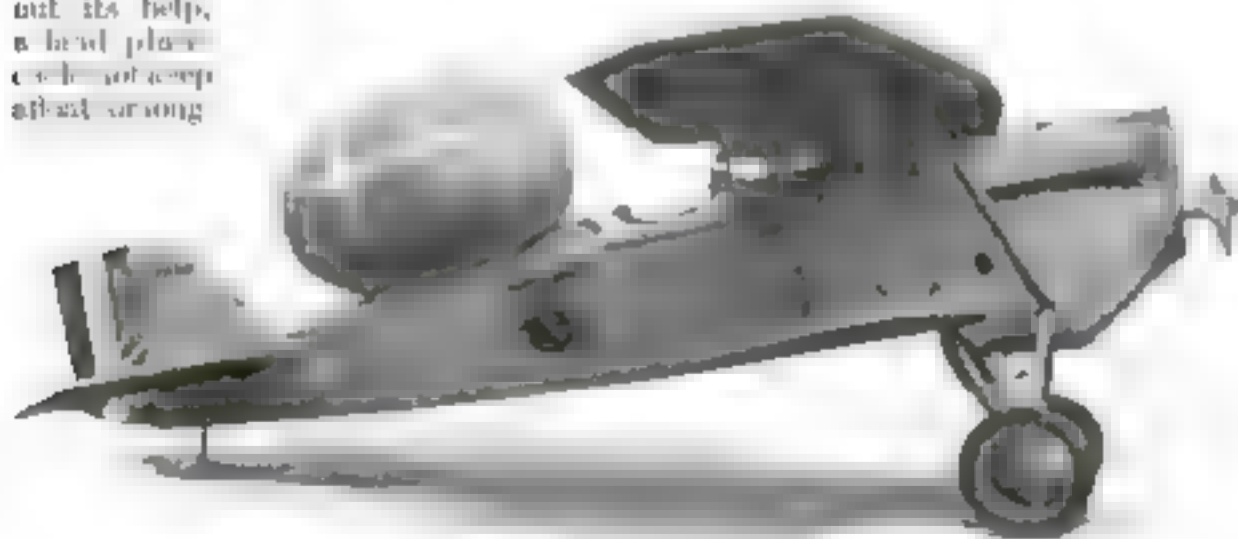


LIKE the first inventors who attempted flight by imitating the birds, Lehman Weil, at Curtiss Field, N. Y., promises soon to take the air in a remarkable "ornithopter" or wing-flapping plane of his own design, weighing 250 pounds. While two fixed wings, not unlike those of a biplane, support it in the air, Weil expects to supply motive power through a pair of bicycle pedals operating flapping wings. These odd propellers telescope into a small area on their forward movement, to minimize air drag, and expand when they swing back to give the plane impetus.

Meanwhile, George R. White, of Stony Brook, N. Y., is testing another odd "ornithopter" in secret in Florida. Though it failed to take the air in a recent demonstration, White says he has flown it eight tenths of a mile. It is launched from a speeding automobile.

Balloon Keeps Plane Afloat

AIRPLANES are changed into life rafts by the latest safety device, developed by the U. S. Navy shortly after several tragedies of attempted trans-Atlantic flight and recently tested at San Diego, Calif. A deflated balloon is attached to the fuselage of the plane. Should he make a forced landing at sea, the pilot operates a lever that inflates the bag with liquid gas in the same manner as with the quick-filling rubber life rafts already in use. The resulting buoyancy is said to keep the entire plane afloat, in a reasonably calm sea, until rescuers arrive. Without its help, a land plane could not keep afloat among



Deflated when not in use, this balloon equipment, developed by the U. S. Navy, can be inflated speedily with liquid gas and will, it is said, keep the entire plane afloat if it falls into the sea.



A general view and an inside close-up of the bicycle airplane and its inventor, Lehman Weil, showing the latter in position at the controls of the queer craft, ready for flight.

A Garden of Invisible Light

TREES, flowers and a fountain glowing in a sunken garden under the rays of invisible light were part of a striking night demonstration recently given to illuminating engineers at Colorado Springs, Colo. The shrubbery had been painted with such chemicals as the zinc sulphide that glows in radium watch dials, and the water of the fountain treated likewise. When floodlights producing ultra violet or "black" light alone were turned on, the foliage appeared in beautifully colored patterns.

Women Are More Like Apes Than Are Men, Says Savant

SIR ARTHUR KEITH'S notable summary of proofs of man's common ancestry with the anthropoid apes, as reported in last month's *POPULAR SCIENCE MONTHLY*, has just been amplified by other world famous scientists.

Addressing the Royal Academy in London, Dr. Arthur Thomson, British anatomist, declared that a baby, until it can walk, resembles the ape in nearly every respect. Women are built more like apes than are men, he added, for as a rule they have shorter legs and longer arms than men.

Dr. Ales Hrdlicka, anthropologist of the Smithsonian Institution, Washington, D. C., recently described his observation of five babies who run on all fours like little animals, instead of creeping on their knees as babies usually do. This unusual trait he concluded, can hardly be explained as anything but a throwback to some animal ancestor ages ago. He cited the report of one observer that it is a common thing for babies in savage tribes of West Africa to walk on hands and feet like young apes.

Arctic Snow Less Than Ours

IN SPITE of its frigid climate, the Arctic region has fewer actual inches of snowfall than ours, official figures reveal. Its dry air, the result of low temperature, can give rise to little rain or snow; the total annual precipitation is seldom more than ten inches, as compared with forty or more in the central parts of the United States.

How Much Do You Know of the World You Live In?

TEST your knowledge with these twelve questions, selected from hundreds sent in by our readers. The correct answers are on page 106.

1. Which ocean has the smallest tides?
2. Where do dates grow in the United States?
3. What river's direction of flow was reversed by man?
4. Where is there underground ice all summer?
5. Where are snakes used to catch mice?
6. Why are most of the West Indian islands rainy on one side and dry on the other?
7. What continents can be penetrated by seagoing ships?
8. What fish almost ruined the Netherlands?
9. What is the Gnu?
10. Where is Mount Sinai?
11. Where does the temperature show the greatest difference between night and day?
12. What people use ants for food?

Panama Gasoline Dyed Green To Entrap Men That Steal It

MOTORISTS who are partial to antiknock gasoline are familiar with the tints used both to give it a distinctive marking and to warn of the poisonous varieties that must not be handled carelessly; but it remained for authorities of the Panama Canal Zone to discover a new use for dyed gasoline in the tracking of Governmental joy-riders. When they found that their stores of gasoline were being depleted by employees on unofficial missions, they added one gallon of green dye to every 1500 gallons of gasoline.

Now, on a holiday, tourists under suspicion may be stopped by police officers and asked to show the color of their gasoline. A telltale green reveals that they have been pilfering Government stores. The dye doesn't injure the fuel.

Scoop to Dig Up Sea Floor

TO BRING up samples of the sea bottom, from depths that a diver could not reach, a heavy bronze "clam-shell" scoop was recently constructed at the precision laboratories of the University of California. It will be used by the Scripps Institution of Oceanography, at La Jolla, Calif., to aid in extensive studying of the ocean floor. Another instrument constructed at the same time will record the depth, pressure and temperature, and will bring to the surface samples of deep-sea water.

Know Your Car

AUTOMOBILE cooling systems are designed to keep the engine at the proper operating temperature in hot, summer weather. This means the cooling effect is much too great for use in fall and winter. In consequence the motor runs too cold, resulting in poor gasoline mileage, lack of power and excessive wear due to rapid dilution of the lubricating oil by unburned gasoline.

One way to keep your motor warm in winter is to fit a thermostat control which will automatically slow down the flow of cooling water through the cylinder jackets. The other is to cover part of the radiator. Radiator shutters and thermostats are part of the regular equipment of several makes of cars. You can fit a thermostat control in the upper hose connection, or you can buy a hand-operated or automatic shutter.

The next best way is to cover part of the radiator with cardboard. The area to be covered depends on the type of car, the temperature, and the condition of the cooling system. Usually the lower third of the area should be covered for average running in winter.

Airplane Hum Lights Up Landing Field



LANDING field lights are automatically turned on by the hum of an approaching airplane by use of the amazing invention of T. Spooner, research engineer of the Westinghouse Electric and Manufacturing Company.

In a recent night demonstration at McKeesport, Pa., a plane 1000 feet up actuated the sensitive control and caused the entire field instantly to be illuminated by a bank of floodlights.

Tuned to the continuous airplane drone, as detected by a microphone, the electric apparatus that is the brains of the outfit responds to no other noise. It receives the sound from a loudspeaker that works in reverse of the ordinary loudspeaker operation, receiving rather than emitting the vibrations, and passes them on to the sensitive device. In this picture are seen

the Spooner invention and, at the extreme left, the light switch that it operates. The equipment is kept in operation from nightfall until dawn.

S O S Calls Absent Operator

BY A new Marconi radio device, a ship can receive a distress signal from a near-by vessel even though the regular operator is not on duty. When there comes through the ether the special new call that will be used—twelve four-second dashes spaced one second apart—the device will respond by an automatic selecting mechanism and sound a bell or other alarm signal. This calls the radio man on the rescue ship to his post to receive the regular S O S with details of the sinking boat's latitude and longitude.

Farm Service Station Assists Passing Flyers



ON HIS farm near Providence, R. I., Arthur C. Gould, pictured here, has one of the first privately-owned airplane service stations. Passing flyers see two signs in his town looking for "Aviation Gas" and "A. C. Gould Farm Landing Field." They may descend and replenish their tanks with the special fuel and lubricant that aircraft motors require. A forge, metal shop and wood-turning plant provide repairs.

For guidance of pilots who pass along the aerial highway without stopping, a 400-foot white arrow points due north.



Sculpture in Snow And Ice



Art That Challenges
Masters Produced in
America, Canada and
Sweden by Women,
Children and Men



Egypt in New England Snow

For his little daughter Priorella, Harry J. Brown of Ware, Mass., made this unusually conceived statue out of snow.



Chicago's Chill Liberty Statue

Chicago boys modeled a snow statue of the Goddess of Liberty. The kids are left to right: George Amman, Elmer Johnson and Rudolph Amrecht, all of Howe Playground.



The Horseman and the Woman

Swedish weather encourages work in ice and snow. The work was a study. The young sculptor of the work is a woman called it. The Horseman and the Woman.

Sled Riders

Swedish ice and snow were combined in making a most faithful representation of a party of children coasting. The expressions of joy on the faces of the youngsters are remarkably realistic.



A Dog Team Fashioned of Canadian Ice

In Quebec Michael Carboneau won admiration by cutting ice into this representation of a team of huskies ready to mush gallantly along over the chill desert of the North.



Teacher Rides Her Own Snow Elephant

Teaching school is only part of the fun of life for Miss Ben Mahoney, of Omaha, Neb. She built this snow elephant so well that he bore her weight and seemed to like it.

Uncle Sam's Scientist Nieces



American Ragam Queen

Miss M. W. Harker measures and calibrates rubber rollers to perfection and calibrates rollers in the Bureau of Standards for the next day.



This Lady Signs President's Name

Miss V. B. Fugate of the Interior Department, authorized to sign the President's name on and patents is shown here affixing that signature to the second largest such document ever issued.

Expert on X Rays

Prof. V. Barron is seen at the right making X Ray film for household of an individual in the U. S. Bureau of Standards. Miss Barron is the youngest field agent and male Professor of Physics at Louisiana College.



Miss Mix, Soft Drink Boss

In her Washington laboratory Miss A. E. Mix tests mineral waters and soft drinks, as shown below. Her family name is more like a name of the kind of their most successful.



Government Star Gazer

Miss Elizabeth A. Lammert, one of the most valuable astronomers at the U. S. Naval Observatory, is shown adjusting a plane through one of the amateur telescopes.



Guilty Microbes in Food Flee When She Pursues

Dr. M. B. Church, microbiological expert in the Department of Agriculture, examines moldy food found in the markets and takes up with the manufacturers ways to overcome such decay. Her work has greatly reduced the national losses and has also improved health.



Her War on Bacteria Saves Farmers Fortunes

Dr. Elsie B. Cram, bacteriologist of the Department of Agriculture, aids with her extensive research in the fight against disease among farm animals and blights that attack crops. Her work against various poultry diseases alone has saved fortunes for American farmers.



Slashing Your Coal Bills

By
JOHN E. LODGE

With an arrangement to heat the house, not outdoors, Smith starts saving fuel

Adequate Fires and Dampers, Drafts and Proper Moisture Keep Heat from Going up the Chimney

COAL wagons had just pulled up at the side of my friend Smith's house when I called the other day.

"Just putting in my winter's supply!" he said. "Looks like a cold winter, so I'm laying in plenty."

"You certainly are," I agreed. "You have a load out there that would do for a dwelling in Siberia."

"Oh, well—I can burn it, all right. It goes up the chimney, one way or another. Anyway, coal's cheaper this year."

And a good many thousand home owners like Smith today are paying needless dollars for coal that "goes up the chimney, one way or another."

For instance, I found Smith was trying to heat his seven-room home with a dinky little furnace fire pot nineteen inches across and a foot deep. Six or seven times a day it demanded coal. It would have cost Smith just thirty-five dollars more to put in a larger fire pot and saved a hundred a year. Twice a day it would need firing.

TO MAKE steam for industry, coal must burn fast. Your home needs a slow, steady fire. The factory uses a fine pulverized coal for fast heat; home furnaces are made nowadays to burn large size anthracite that delivers its warmth slowly. The secret of home furnace economy is to fill the fire pot with a sizable quantity and let it consume itself in leisurely fashion.

When Smith wanted to force his fire, he opened the ash-pit door. Fine, for it let in a strong up-draft through the fire bed. But a fire needs air above it, too.

"Try opening the draft slide in the feed door a little," I told him. "Not wide—that would check the fire—but a fifth of the way across. With your ash-pit door open, that gives complete combustion."

"While you're here," Smith said, "explain why every time the wind blows

hard, it seems, the furnace needs another load of coal. A strong draft, and it seems to burn itself out."

"That's one of your biggest wastes," I told him. "Most of your heat goes up the chimney. You should have a secondary damper in the smoke pipe, arranged so it will kill the draft when the wind blows. It's easy to put in, and it will cut your coal bill in half on a windy day. As for my plant, I simply hung a loose trapdoor in my smoke pipe. When the wind blows it opens, and the air runs through it instead of up through the fire. During a calm, it swings closed."

THERMOSTATS are cheap and they'll automatically slow down your fire when it gets uncomfortably warm. No need to open the windows and try to heat the great outdoors.

"Of course, it is a good plan to change the air of a house frequently—once an hour is a good rule—to keep it from getting stuffy. If your windows are loose, that will help—but it's a wasteful way; mine are weatherstripped. Air slots that let in air when you need it are good."

"Here's a tip that may save you money. You'll be every bit as warm and comfortable with moist air at sixty-five degrees as with dry air at seventy-five or more. Put a spray in your steam or vapor radiator, or pans of water on the backs of your hot-water radiators. If you use warm air, place a pan of water in the drum of the heating plant. Wet the air where it enters the room, and the moisture will circulate with the heat."

"When you go to bed, do you let the fire die down—to be revived with a vigorous forcing in the morning? It takes much more coal to warm up the cold house than to keep it at a steady temperature. By the time the house is warm you can't check the fire in time to keep from wasting coal. Instead of opening the check damper at night I close the furnace

practically a-tight and let the stack damper check it."

"What sort of coal should I use?" Smith asked me.

"It's a question of the draft that you have," I replied. "With your own draft uncommonly strong, I'd suggest filling in the chinks between your range-size anthracite with a little chestnut or pea coal. That will control your fire. My neighbor, who has a fair draft, gets along nicely with the range-size alone."

"How about coke?"

"Egg coke and number one nut will give you the same results as range and pea coal. Don't use pea coke, ever. It makes clinkers, except in furnaces that have magazine feeds—the same arrangement that you see in base-burner stoves."

"Could I burn soft coal if I had a magazine feed?"

THERE'S no reason why you should burn anything else; you wouldn't need to buy expensive grades. But even without a magazine feed, you can use soft coal if you know the tricks. For a very strong draft like yours, nut size alone or mine run works best. Egg and nut, mixed, is the prescription for a moderately strong draft. A weaker one calls for egg coal.

"Using soft coal of any size, you have to break the crust every two hours if you want a hot fire—or leave it alone if a slow one will do. If a hole burns through the fire, fill it up with fresh coal, or you'll waste heat. When you fire in the morning, do it piecemeal—fill half the furnace, say, before breakfast and open the drafts wide. Then you can fire the other half, and set the drafts, forty-five minutes later. With anthracite or coke, you should be able to fill the fire pot just once, regulate the drafts, and forget it."

"There's more to burning coal than I'd supposed," Smith said.

Yes, there is considerable. And it pays to look to the fine points."

"Ghosts" in Your Loudspeaker

How you hear sounds that don't exist, and other curious effects revealed by new tests

By
ALEXANDER S. NAUKE, E. E.

SOUNDS that appear and disappear like Will-o-the-Wisps—sounds that you can hear when they don't exist—these and many other startling effects have cropped up during elaborate investigations of loudspeakers made in the laboratory of the Popular Science Institute of Standards.

At first glance, testing a loudspeaker appears to be a simple matter. All a loudspeaker does, or at least all that it ought to do, is to transform electrical vibrations into equivalent air vibrations. Measuring the electrical vibrations fed into the loudspeaker and comparing them with the measurements of the air vibrations produced by the speaker certainly would tell the whole story.

But it is much easier to tell how loudspeakers ought to be tested than to work out methods for doing the job.

For the complicated vibrations in the air that are interpreted by your ear as loud music, say, and the corresponding electrical impulses, are extremely hard to separate in such a way that you can definitely measure the strength of each individual vibration.

EVEN the musical sound produced by a single instrument is made up of many vibrations at different rates. The fundamental note, the one by which the instrument is tuned, always is accompanied by several other vibrations that are known as overtones or harmonics.

The human ear depends so much on the overtones or harmonics to identify a sound that it actually will identify it as made by some particular instrument or voice even when the fundamental tone is completely absent.

That is why you can hear the sound of a bass drum or the low notes of an organ over a radio set and through a loudspeaker that are incapable of reproducing the real fundamental notes of such musical instruments.

Two loudspeakers in the laboratory were fed with uniform electrical vibrations of exactly the same frequency. The speaker which sounded weakest actually reproduced in sound the precise frequency being fed into it, while careful measurement showed that the other, which sounded much louder, was not reproducing the original frequency at all. Instead it distorted it into several harmonics that fooled the ear into hearing a sound that didn't exist!



Loudspeakers yield their secrets in the Institute when placed on the phonograph merry-go-round as shown at the right. A tuned galvanometer, at the left, plays an important part in the measurement of amplification at various frequencies and in the analysis of loudspeaker distortion.

If such a loudspeaker were called on to reproduce the enormous number of tone frequencies of a band or orchestra, the tones of many of the instruments would be lost in the shuffle.

Mysterious now-you-hear-it and now-you-don't sounds were discovered when pure, single-frequency musical notes were produced by a loudspeaker. Their erratic behavior is accounted for by the fact that the sound wave traveling direct to your ear from the loudspeaker and the waves that are reflected from the walls and ceiling of the room interfere with each other. When they are in step you hear the sound. When they are out of step they cancel each other.

Each movement on your part changes the relative paths of the direct sound wave and the reflected ones, and because the higher tones are shorter in wave length, the changes come much more rapidly with the high notes.

YOU don't notice this effect at all with ordinary music, which consists of many different tone frequencies, because each one has a different wave length, so that only a few of the total number are balanced out at any particular distance from the source of the sound. It is only when the sound is a pure musical note without overtones that the effect is really pronounced.

This particular effect is of great importance in the testing of loudspeakers. Obviously, you cannot measure the strength of a sound with any degree of accuracy if the sound is going to appear and disappear with the slightest change in the location of the measuring instruments. It wouldn't do any good to keep the instruments at a definite spacing, because each tone frequency disappears at a different distance.

Fading radio signals, which are considered by scientists to be due to chang-

ing conditions in the upper atmosphere, could be duplicated with pure sound waves merely by arranging the ceiling of the room so that it could be raised or lowered. If the position of the ceiling were gradually changed, the intensity of the sound you heard would also vary.

IN SPITE of the peculiar actions of pure tone sound waves, a way has been found in the Popular Science Institute radio laboratory to measure their strength with extreme accuracy so that it is possible to determine how well a loudspeaker reproduces all audible frequencies from the lowest to the highest.

As shown in the illustration the loudspeaker was placed on a phonograph turntable arranged with sliding contacts to carry the electric current to the loudspeaker windings. As the loudspeaker rotates you hear sound go up and down in volume. But the average strength of the sound at any point in the room was found to be the same at all other points equally distant from the loudspeaker. By using slow reading electrical meters it was found possible to get a true average reading and the last problem was solved.

So now when a loudspeaker comes into the laboratory for test, it has no more chance of concealing its defects than a counterfeit bill has when it slides over the counter into the hands of a bank teller!

IF IT won't reproduce certain tone frequencies, that fact is discovered in short order and any distortion introduced by the loudspeaker itself is revealed and the amount of distortion is quantitatively measured.

A booklet of twenty pages that will prove helpful if you are buying, installing or operating a radio receiver, together with a complete list of tested and approved radio apparatus, can be obtained for twenty-five cents from the Popular Science Institute, 350 Fourth Avenue, New York.

How to Get Started in Radio

With Homemade Crystal or One-Tube Receiver You Can Tune-in What You Want, When You Want It, and Learn

By ALFRED P. LANE

HAVE you a hankering to find out what makes the wheels go round in radio?

Do you often want to tune in jazz when the rest of the family insist on classical music? Would you like to be able to listen in for an hour or two after the others have gone to bed and you can't run the regular set for fear of waking them?

It's possible to kill these three birds with one stone. A little experimental work on your own account will do it. And the expense won't amount to much when you compare it with the satisfaction and knowledge of radio fundamentals you'll derive from the work.

There are two ways. One is to assemble a simple but modern type of radio set using a crystal detector. The other is to put together an equally simple one-tube receiver. Each outfit has its particular advantages and disadvantages that make it suitable for use in certain conditions.

The fact that you may never have played with radio apparatus beyond connecting up the batteries on the family set is no handicap. You don't even have to know enough about electricity to hook up a door bell.

A CASUAL inspection of the modern family radio set with its many tubes and tightly sealed cans containing all the working mechanism will give you the impression that radio is complicated and full of mysteries. Actually it is simple enough if you take the theories for granted and confine your activities to working out the practical means by which the radio waves are received and converted into sound waves so that you can hear them.

The first fact with which you are concerned in working out the answer to the three questions is that radio waves will flow down any wire suspended in the air to the nearest point on the wire that is metallically connected with the earth as, for example, by a pipe that you have driven into the ground or by your home water supply pipe.

These electric waves are alternating current precisely like the alter-



Fig. 1. This modern crystal detector unit uses a corundum crystal under heavy pressure so that it doesn't get out of adjustment when set is moved.

nating current in the electric light wires in your house, except that in the house current the alternations are at the rate of 60 cycles a second, whereas the electric current induced in your antenna by the broadcasting station vibrates at an enormously high rate. At 200 meters wave

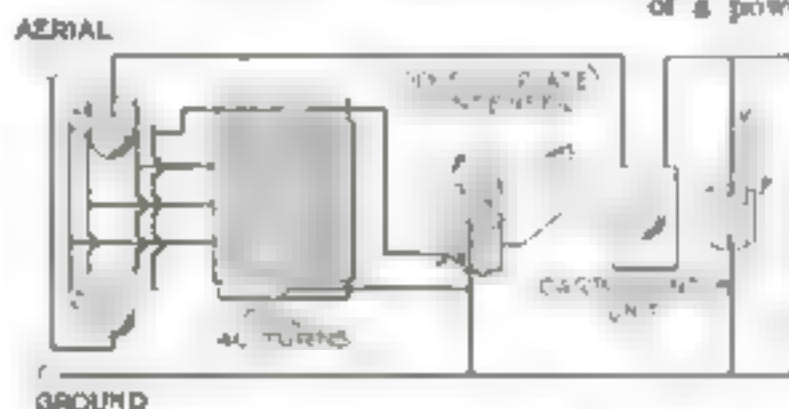


Fig. 2. This circuit will give you the best results obtainable from a crystal detector. Its steady working range is about 25 miles, with fair volume.

length the alternations of the current approximate 1,500,000 cycles each second.

If you cut the antenna wire near the ground and connected the two ends to a pair of headphones you couldn't hear a thing, because the metal diaphragms of the headphones would be too heavy to vibrate at this enormous rate, and even if they did your ear wouldn't register any sound whatever, for the human ear records only vibrations up to about 30,000 a second.

The sounds produced in the broadcasting studio are impressed on this high frequency carrier wave. This means that the alternations of the carrier wave are made to increase and decrease in intensity in time with the sound vibrations. But still you can't

hear a thing through the phones connected as mentioned. Although the vibrations vary in intensity, they are too rapid to affect the phones.

But you can make them audible in a very simple manner. Connect a crystal detector in series with the headphones and the antenna. The crystal allows current to flow through it in one direction only. It cuts off all the pulsations flowing in one direction. This leaves groups of pulsations in one direction which correspond with the sound vibrations. Each group of high speed pulsations acts like thousands of tiny threads pulling the diaphragm in one direction and then releasing it.

AUDIBLE sound is the result, and if you live within a few hundred feet of a powerful broadcasting station you can hear all that goes on in the studio with no other apparatus than a pair of headphones, a crystal detector, and a wire suspended in the air.

The same result with slightly more volume can be obtained by substituting a vacuum tube for the crystal detector, because the vacuum tube is better than

the crystal as a rectifier.

But such a method is very inefficient. It doesn't take advantage of the fact that the broadcast wave is sharply tuned to one wave length so that it will set up far more powerful electrical oscillations in any circuit tuned to the same wave length.

And with the addition of the necessary parts to accomplish this tuning, you have a modern crystal set such as is shown in Figs. 2 and 3.

EARLY types of crystal sets, such as were used before vacuum tubes were invented, employed an open crystal and a tiny wire, nicknamed "cat whisker," to make contact with it. Results depended on a minutely accurate adjustment of the cat-whisker on a particularly "sensitive" spot on the crystal. The slightest jar would throw it out of whack and then the exasperating hunt for a sensitive spot had to be gone through all over again.

The modern crystal set shown in Figs. 2 and 3 gets rid of these troubles by using a corundum crystal encased in a sealed cartridge with the metal contact under heavy pressure. The crystal unit is shown in Fig. 1 with a small single flashlight cell that is used to force a tiny flow of direct current through the crystal. This

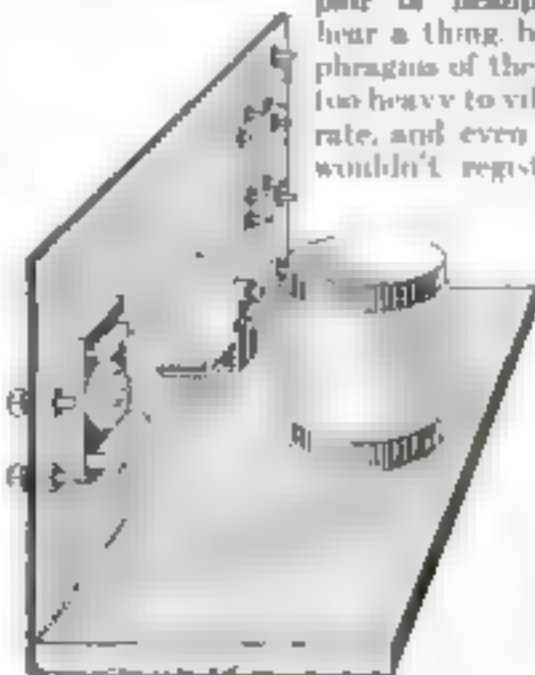


Fig. 3. The arrangement of the apparatus for the simple, efficient, crystal set. It gives perfect tone quality on the headphones.

minute amount of current makes the crystal more sensitive.

Assuming that there is a pair of headphones around the house, perhaps a relic of the days when the family was interested in distant reception, the only expense connected with assembling a crystal set will be the purchase of the detector unit, a variable condenser, a small fixed condenser, some binding posts, switch points and a pound of bell wire.

THE arrangement of the apparatus on the wooden baseboard and the panel, which also can be of wood, is shown in Fig. 4 and the wiring of the instruments is shown in Fig. 5. The coil form can be a rolled-up piece of cardboard four inches in outside diameter. Bell wire is used for the tuning coil. Wind on forty turns with a lap every ten turns.

This little crystal set will reproduce the broadcasting with practically perfect tone quality. In this respect it probably will be superior to the big family set, unless the latter is a high grade, expensive instrument.

But you mustn't expect the little crystal set to be in the same class as the big set for distance and selectivity. It will choose between local stations only if they are widely separated in wave length, and the distance range under normal conditions is limited to about twenty-five miles. However, like the fisherman who goes after big fish with light tackle, you will undoubtedly have a lot of fun fishing for distant stations late at night and when you are lucky enough to bring in a station a couple of hundred miles away on a particularly good night you can take pride in the accomplishment.

WHEN there are no stations nearer than ten or fifteen miles you will find that a simple vacuum tube set will better serve your purpose than the crystal set.

An up-to-date yet simple set of this type is shown in Figs. 4, 5 and 6. Figs. 4 and 6 show actual views of the receiver as assembled out of standard parts, and Fig. 5 is a picture diagram that shows the wiring, including antenna and ground.

The coils A, B and C are wound on a cardboard or bakelite tube three inches in outside diameter with No. 22 double silk covered wire. The coils are all wound in the same direction. Coil A has twelve turns, coil B, sixty-eight turns, and coil C, sixteen turns.

D and E are variable condensers of .00025 mfd. capacity (15 plate). You can use .0005 mfd. (25 plate) condensers by changing the number of turns in coil B to 50. F is a fixed condenser of .00025 mfd. capacity and G is a standard vacuum tube socket. H, the rheostat, should have 30 ohms resistance. I is a standard 2-megohm grid leak. J is a standard jack and K is the filament switch used to turn out the tube when the set is not in use. L and M are the panel and baseboard.

As shown in the illustrations, this one-tube receiver is arranged for use

with the 199-type dry cell tube that is operated on three No. 6 dry cells connected in series. One set of three cells will run the set for a couple of months if used nightly.

The set operates perfectly with the ordinary 201A-type tube if you intend to locate it near enough to the big family set so that you can run two wires from

the storage battery used on the regular set and thus avoid the purchase of the No. 6 dry cells.

It is well to fit the set with one of the new X-type sockets at G because this socket will take either the 1X 199 tube or the 1X 201A tube. Rheostat H should have a resistance of 20 ohms if you use a 201A tube. It is also possible to substitute a self-adjusting rheostat for the hand-

adjusted type shown at H. This will eliminate one control without affecting the operating qualities of the receiver.

It will make the change from one type of tube to the other extremely easy. These self-adjusting rheostats are in cartridge form, held in place by clips, so you merely clip a type suitable for the 199 tube in place if you use that tube on dry cells, or another style if you use the 201A tube on the 6-volt storage battery.

WHILE the tuning of a single-tube receiver of this type is relatively simple, there are certain rules to be observed in handling the set if you want best results in reception without creating a disturbance that will spoil your neighbors' reception.

Stations are located by turning condenser D and regeneration is controlled by condenser E. As this condenser is turned so that the plates engage, the signal becomes louder and louder and at the same time the tuning becomes sharper and sharper. At a certain critical point on the dial of condenser E you will find that the signal becomes mushy and unintelligible. If you leave condenser E at this point and again juggle with condenser D, it is possible to get the signal fairly clear, but don't tune any single tube set in this way. It will radiate and cause wavering whistles in every other set within a surprising distance of your house.

When properly operated the single-tube set will not cause any interference. You should keep the dial on condenser E below the point where, if you turn condenser D, squeals are produced.

Of course there is no possibility of such trouble with the crystal set first described, for a crystal set cannot regenerate. That is one of the principal reasons why it is not so sensitive or so selective as a vacuum tube set.

The vacuum tube itself, considered merely as a radio detector, is not very much more sensitive than a really good crystal, but the function of coil C, or a similar coil in other circuits, is to feed the signal back into the tube again and again so that its volume is built up about as much as if a single stage of radio-frequency amplification were used ahead of the detector tube. But when you carry the process too far the tube actually produces oscillations in all respects like those produced in the broadcasting station except, of course, on a much smaller scale. In fact, a regenerative single tube set when in oscillation actually is a broadcasting station so far as the principles of operation are concerned.

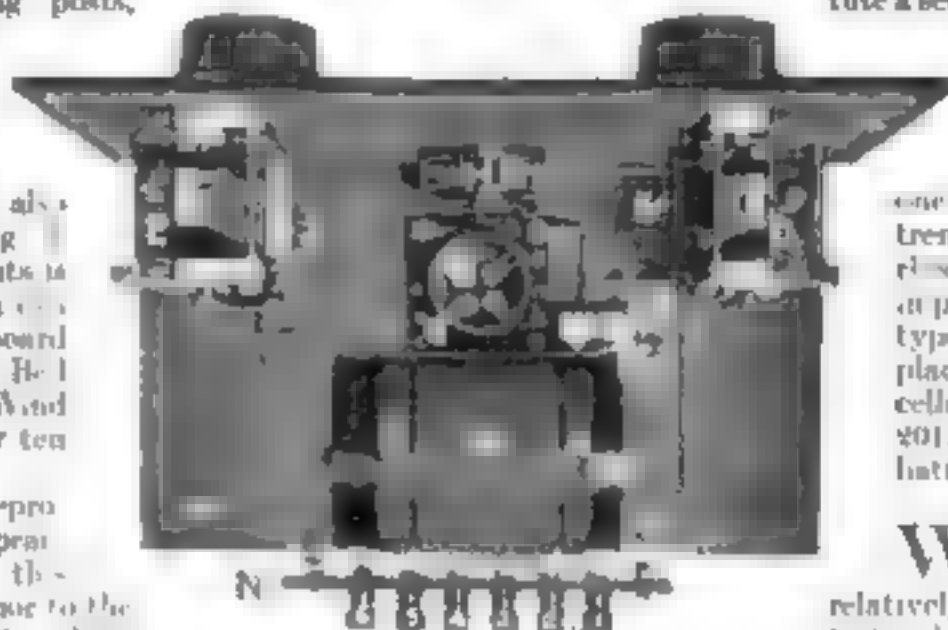


Fig. 4. This vacuum tube set gives the best results obtainable from a single tube, getting broadcasting stations 500 or more miles away on the headphones.

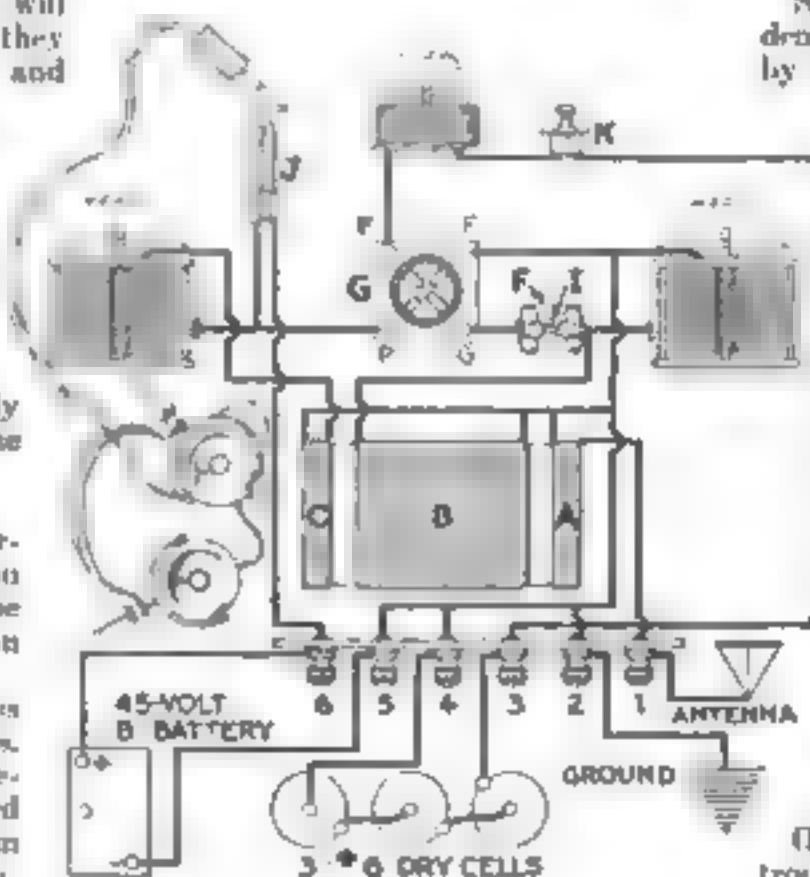


Fig. 5. This picture wiring diagram is complete, including antenna and battery connections, if you use the dry cell tube type 199. For best results with this outfit use a long and high outdoor antenna.

Fig. 6. A panel view of the one-tube set. The left-hand dial is used to find stations and the right-hand dial controls regeneration. Properly operated, it causes no squeals in your neighbor's radio set.



Mechanical Servants



Put a little water in the receptacle below the holder in the egg cooker shown above and at the right. Set the egg in the holder, cover it with a glass and turn on the current. The steam cooks your egg to the degree determined by the amount of water you used and when all the water is gone the current stops automatically.



Lifting your iron is minimized by this electric stand that is conveniently low. Its self-contained switch cuts off the current when the iron is placed on it, so electricity is used only when heat is actually required. The device is said to cut current bills.



Corks that have swelled so that you can't get them back into the bottle are mastered by the cylindrical squeezer operated by hand pressure. After the stopper is squeezed the plunger carries it into the bottle neck. The plunger then withdraws and the cork swells again, fitting as tight as when first inserted.



A cork with a glass spout fitted into it that makes pouring easy is seen below. Usually the spout is inside the bottle. In wet corks when you wish to use spout.



Now we have glass modies, hollow and filled with gaily colored bits of thread, they add a colorful touch to the living room, and they do not melt and sag on warm days. They will not burn, but a little tuft of thread makes a satisfactorily decorative "flame."



The utensil at the left combines an individual bread loaf holder and slicing device. The bottom is a cutting board, with troughs at each side to catch crumbs. Draw out the loaf and cut as you need it, the curved wire arch guiding your knife to make even slices.



There is no excuse for unpressed trousers when one has the pressing machine pictured here, which with half a cent's worth of current is said to crease your trousers perfectly while you are having your morning shower. The top and bottom are of steel lined with cloth. Between the trouser legs goes a heating pad. This and the linings above and below are moistened, the garment is clamped in the machine and the current is turned on. The resulting effect is said to be exactly the same as that of the goose and damp cloth used by the tailor.

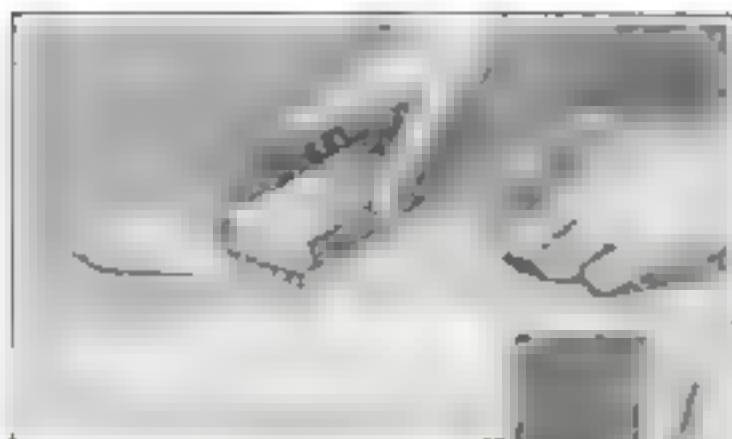


To Aid in Housework



Flip your gloves into hand-shaped celluloid forms and they are easy to scrub. Leave them on the forms for drying, which is hastened by wrapping them in a crash towel.

A coffee container that measures out your supply in spoonfuls or the quantity you determine is shown at the left. Each revolution releases into the percolator the exact amount required to make one cup.



You can watch your coffee percolate in a new utensil that is made of oven glass, which is impervious to heat. And it is easy to make sure with the eye that it is clean. Only the coffee holder within is made of metal.

An alarm that is proof against being let down by the current is shown at the left. Only so long as you are using the iron and your thumb rests on the switch is the current on. When you quit it springs back, breaking the circuit.



Roll the electrical laundry up to the washtub and it will sponge the clothes about in the soapy water until they are clean, according to the inventor, and then they are easily run through the attached electrically operated wringer. The "laundress" has other turning attachments that will turn the ice cream freezer, grind meat, beat eggs, sharpen anything from knives to skates, polish shoes and, with a little direction, trim trousers, its makers declare. Only a few cents' worth of electricity is said to be required for savings of many dollars.

Have you ever wanted to run a wire for an electrical attachment under a carpet without making an unsightly and dangerous ridge? Here at last is a way to do it. The electric cord at the right is thin and flat as a piece of tape. Its wires run beside instead of around each other and are embedded in strong rubber insulation.

A pure gum rubber milk bottle cap that grips the bottle as shown below is air tight and germ-tight and makes the bottle safe for traveling or for resting on its side in an over-crowded ice box.



Drop this little package in the soiled linen hamper or hang it up in any place where there is an offensive smell and the powerful deodorant working through the holes in the metal shell will purify the air. Its portability and its smallness are obviously great advantages.



Sam Loyd's Brain Bafflers

Put Your Wits in High Gear

Puzzles That Test Accuracy and Speed in Thinking

PUZZLES that are not only amusing and entertaining, but train the mind to think swiftly and accurately, are presented each month on this page by Sam Loyd, the world's foremost puzzle maker. They give you fun without wasting your time. See how quickly you can determine the answers. Then turn to page 145 to learn the correct solutions and the time in which you should have found them, and thus see how well your mental machinery is "tuned up."

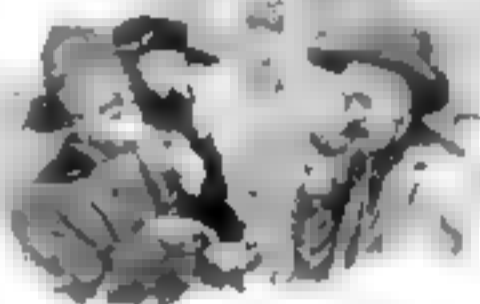
Oldest Puzzle in the World

BELOW is a specimen of the magic square, probably the oldest form of mathematical puzzle extant. Magic squares were constructed in India before the Christian era, and their introduction into Europe was due to Moschopolus, who lived in Constantinople in the early part of the fifteenth century. They have always remained a classic of puzzle-dom.

A magic square consists of integers arranged in the form of a square, in such manner that the sum of the numbers in every row, in every column, and in the two diagonals is the same. An interesting feature of the magic square is that the arrangement of the numbers is susceptible of variation. For example, it will be noted that the corner numbers are 1, 4, 13 and 16, and the common total of the rows, columns and diagonals is 34. Now, let us see who can arrange the sixteen numbers into another magic square, wherein the corner numbers will be 1, 4, 12 and 13, and the common total remain as before.

The first few minutes of effort will show you that the task is no easy one. See what you can do with the problem. After you have solved it or given it up turn to page 145 for the correct solution and the time in which a person of average ability should reach it.

1	14	15	4
12	7	6	9
8	11	10	5
13	2	3	16



The Prospector's Fortune

THREE old prospectors, who had made their "pile," were reminiscing on the road back to civilization.

"If I were to stay on for another year, and gain at the same rate I have accumulated wealth during the time spent in these parts," remarked Jim, "I'd be worth a cool million."

"At the rate I have stacked it up, it would take another nineteen years to get in the millionaire class," said John.

Then Bill had his say.

"I'd have to go on digging and saving the same term over again to get my thousand thousand dollars," said he, "and I've been out here as long as you two fellows put together."

Jim continued on to the "soft life," but Bill and John changed their minds about quitting, and went back to the hills for six years more, where they toiled and saved with the same success as previously.

Bill quit with a fortune of \$600,000, and John's pile was \$473,000.

Now who can tell how much Jim retired on? See if you can determine the amount of his "pile." Then turn to page 145 to learn the correct answer and the time allowed for working it out.

Troy and Avoirdupois

FOR an up-to-date answer I will submit a problem sometimes regarded as old: What is the difference in weight between six dozen dozen pounds of feathers and half a dozen dozen pounds of gold?

Perhaps you imagine you solved this bewhiskered poser years ago, but the chances are your instantaneous answer was faulty. The question is a test of your knowledge of practice in weighing commodities. It is in the nature of a "catch question," and the proper solution depends on your ability to consider all the facts in the situation stated and to think precisely. For the correct answer and time allowed to find it, see page 145.

Coats, Vests and Trousers

A MERCHANT stocked his store on an investment of \$795, for which he purchased one-fifth as many garments as the number of dollars he expended.

For vests he paid \$2.45 each; for trousers, \$4.90 a pair; and for coats, \$12.25 each. He invested his money so as to have the largest possible number of complete suits.

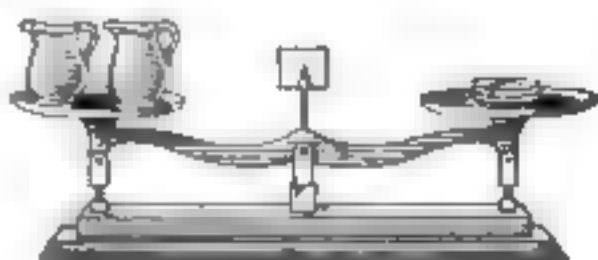
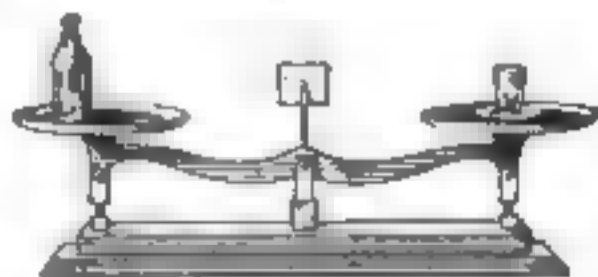
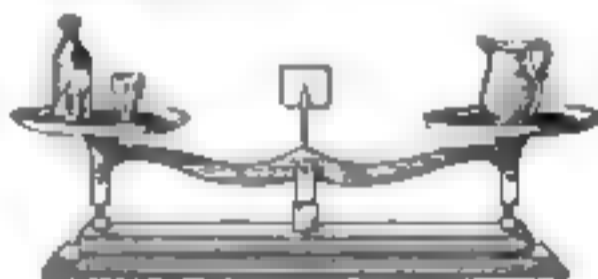
Put yourself in his place and figure out how many coats, vests and pairs of trousers he was able to buy. Then look on page 145 for the correct answer and the time allowed for finding it.

Weight of a Bottle

ON THE top scales we have a bottle and tumbler balancing against a pitcher. On the middle scales, that same bottle is shown to weigh equal to the tumbler plus a plate. On the bottom scales, two pitchers exactly like the one on the top scales are shown to be of the same weight as three plates, similar to the plate on the middle scales.

There we have sufficient data with which to answer the question: What is the weight of a bottle expressed in tumblers?

See if you can determine the answer. Then on page 145 you will find the correct answer and the time in which you should work it out.



Sam Loyd has prepared another set of his fascinating puzzles, which will appear in this magazine next month.



Build for Utility First in Home

Too Much "Art" May Ruin Your House, While Jazz Designing Surely Will

By JOHN R. McMAHON



Photograph by Portland Cement Association

WHAT kind of a house do you want, sir?" asked an architect of his client a century and a quarter ago.

"The best in design and materials, with all modern improvements," replied the substantial American citizen. "I want high ceilings, not less than seven feet for the first floor. The outer walls for the first story must be two feet thick, faced with stone and backed with chopped straw and clay."

"Excellent," beamed the architect. "The headroom will be more than ample. There is no better mortar than well-puddled clay. I presume you wish the wood framing done in the old reliable mortise-and-tenon style?"

"Naturally. Floors of oak plank a foot wide, pegged to the joists beneath. Not more than three different floor levels at the first story. I want one large fireplace and a couple of little ones."

"Would you consider a new heating system, sir?"

"What is it?"

"The fire is inclosed in an iron chamber," explained the architect, "with a pipe to convey the smoke to the chimney. It is called the Franklin stove, after its famous inventor."

"I like to be up-to-date," said the client, "and I am willing to take a chance on a small model. Now tell me what this house will cost."

"Since it will be thoroughly modern and embody the latest conveniences," said the architect, after rapid figuring, "I estimate the cost at \$1,350."

"Too much," pronounced the client, "especially when I supply stone, clay and raw lumber. The cost of building has become unreasonable. I won't pay a cent more than twelve hundred."

"I'll do my best, sir, to reduce

the estimate," replied the unhappy architect, "but you know the wages of our workers such as joiners and masons have gone up to five cents an hour. A luxury like an iron stove adds expense. Glass is costly and you insist that every room have its window. However, I will attempt to meet your wishes by certain economies."

This colloquy of yesteryear could be translated into a present version without great difficulty.

WHAT people want in home building today is what they have always wanted—the best and newest of everything at a price they can afford to pay. There is the same argument over cost and the same adjustment by manipulating the factors of quantity and quality. The old house had to be reduced in size, its framing timbers were not four-squared, the wall mix of straw and clay was thrown in place and lacked thorough tamping. But improvement he was bound to have, and whatever economies prevailed, we can be sure that the ancestral American installed the new-fangled heating system. We owe him thanks for this spirit of enterprise which fostered the climb from the open

Above: A distinctive six-room and two bath brick home designed by William Carver. Below: Daring use of naked concrete blocks—a six-room cottage designed and built at Larchmont, N. Y., by C. C. Merritt.

fire to the coal furnace and oil burner.

In architectural design there has been a great change from the forms not only of Colonial America, but of the last medieval century. Today our houses embody a multiplicity of styles, ranging from the classic Greek to the Scotch cottage, from the Spanish villa to the tent-roofed structure of the Chinese. And it is possible to see most of the world's models, of every clime and historical period, assembled within one suburb of an American city. The exhibit has been enlarged by the contacts of the World War. French chateaux and English cottages and Rhine castles in reduced dimensions have been put up on this side of the ocean.

NOBODY can tell what is the exact trend of present style, but it is said that the English cottage—which is a chunky, rather haphazard design—now rivals the half dozen varieties of native Colonial. Architectural style, especially when it is a remote borrowing, cannot be taken very seriously. It should be judged by the principle of use. Certain types were developed to meet the conditions of

native climate, and when these types are transplanted to another zone they are evidently misfits. The sharp peak roof that sheds New England snow is as out of place in southern California as is the low roof of the Spanish or Mission bungalow in the cold North. The tendency to disregard such basic facts and to pursue the chimera of art for art's sake is deplored by the more intelligent designers.

An American millionaire's mansion sports about a dozen great chimneys. Why? Because the foreign antique original needed them for its open fireplaces. With an oil-burning furnace, most of

Homebuilders' Queries Gladly Answered

THAT POPULAR SCIENCE MONTHLY has attentive readers in many remote parts of the world is shown by letters of inquiry to its Home Building Department and to John R. McMahon, who conducts the department. Alaska wanted to know about a schoolhouse. Japan and the Gold Coast of Africa wished advice. Costa Rica desired a line on American window manufacturers.

India spoke through the Maharaja of Dhrangadira, wishing knowledge of the bacterial method of dealing with rodents.

Bagdad requested plans for a bungalow.

Of course, many American readers are heard from.

Our Home Building Department is delighted to answer all inquiries from far or near. Address the Department or John R. McMahon, POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York City.



Left: An English type cottage of stucco put on metal with a chimney gun. The roof is slate covered.

Below: This woman, a housewife, was made of brick, variously cut and put on a wall. The chimney gun is a chimney gun, and the chimney gun is a chimney gun.

these chimneys are as surplus as chimney smokestacks on an old turbine steam engine.

I know of an owner of a house who bought some ten-by-ten tiles to be vividly incorporated in the ceiling of his living room. In his absence the builder omitted them. The returning owner lectured the builder on his crime against art and had him put in the beams, regardless of their zero value as supports.

Any sympathies are with the untutored but common sense builder. In time past beamed ceilings were essential, while to day they are decorative make-believe. Furthermore, the ceiling of a living room is better cut down to the level of the ceiling of a kitchen. The best illumination is obtained by reflection of light from a white ceiling.

The practical needs of a house, determining suitability to climate and site, should come first. Afterward let the designer embroider a bit with nonessential details, such as a line of false roof, if you can afford it. But don't let him lop off a useful front-door porch on the ground that it "hurts the composition." Houses must be lived in, not merely looked at.

WOMEN today dictate largely the style and quality of houses as they dictate the types of automobiles. There are good and bad consequences. Women call for a presentable, sometimes a showy front. They favor casement windows and are particular about period details, paint and a main entrance equipped with distinctive hardware. The living room must be choice, with harmoniously decorated walls, enamel or other quality finished trim, tasteful fireplace, handsome interior doors, and a hardwood floor. The last item at least has substantial merit.

Then the woman shopper may seek a guest bedroom that is suitable for important and particular visitors. The bathroom, singular or plural, is subject to critical scrutiny. If the tub is built in, the floor tiled, the walls at least half tiled, a glass door medicine cabinet inset and a few other refinements supplied, the house is well on the way to being sold. A substitute for real wall tile, which is enameled wallboard of wood fiber, often passes muster whether or not it is mistaken for the kiln product it so closely resembles.



The kitchen meets approval if its walls are half tiled, its floor covered with a suitable pattern of linoleum, if there is an up-to-date cook range or suitable space for one beneath a shiny smoke hood, an electric or gas refrigerator or its site, an ample sink and conveniences in white porcelain and nickel. The layout must be convenient for kitchen work and service to dining room and breakfast nook or alcove. A discriminating minority look for well placed lighting fixtures in the kitchen as elsewhere, as well as for plenty of electrical convenience outlets at knee-height along the walls. A folding ironing board always makes a hit. So may other folding devices, from beds to breakfast outfits. There is considerable magic in the garbage incinerator built into the furnace chimney. Even tin cans are fed into the incinerator.

The customer is practically ready

to have her husband sign on the dotted line, but pauses to ask about the hot water supply. Naturally, the hot water system is ideal, automatic in winter by furnace connection and as automatic, or almost so, in summer. Heating the house? Of course there is the best oil burner on the market; runs all by itself from October to May, keeping the temperature of the house always within one degree of constant.

"Step downstairs, madam, and take a look at this neat and noiseless little machine. Observe this spotless cellar, which can be divided off into an extra room or two, adding just so much living space to the house."

The woman is convinced, delighted. Her husband is apt to grumble.

"**MARY**, you wanted a green roof and white walls. That's why this house took your eye in the first place. This roof happens to be cheap at \$100 and it will have to be replaced in a few years. There are hardwood floors downstairs but how about upstairs? What is under the kitchen linoleum? I don't know what is inside the walls. If they have insulation against heat and cold, that's more to the point than pretty trim in the living room. That oil burner may and may not be right. I want to study this house before we make a decision."

The husband might as well save his breath, knowing who makes the decision in this family. Why, this is simply a darling home. It has every comfort, including large closets which are self-lighted just by opening the closet door.

There is a great new diversity in building materials today. Among them are wall blocks of excelsior base, facing slabs of wood shavings mixed with plaster, units of aerated gypsum and concrete, cinder cement blocks, wallboards of sugar cane fiber, rye straw and, most recently, wheat straw. There is a merry war among materials, both natural and artificial, to seize or hold fields of use once regarded as safe from invasion. Lumber is rivaled by made-up fiber substances; natural stone, by concrete and other combinations; brick and tile by materials that never saw the inside of a kiln. Doubtless a number of products deserve the old-fashioned stigma of "substitute," but such a label is unfair to many newcomers that in due time will be regarded as standard.

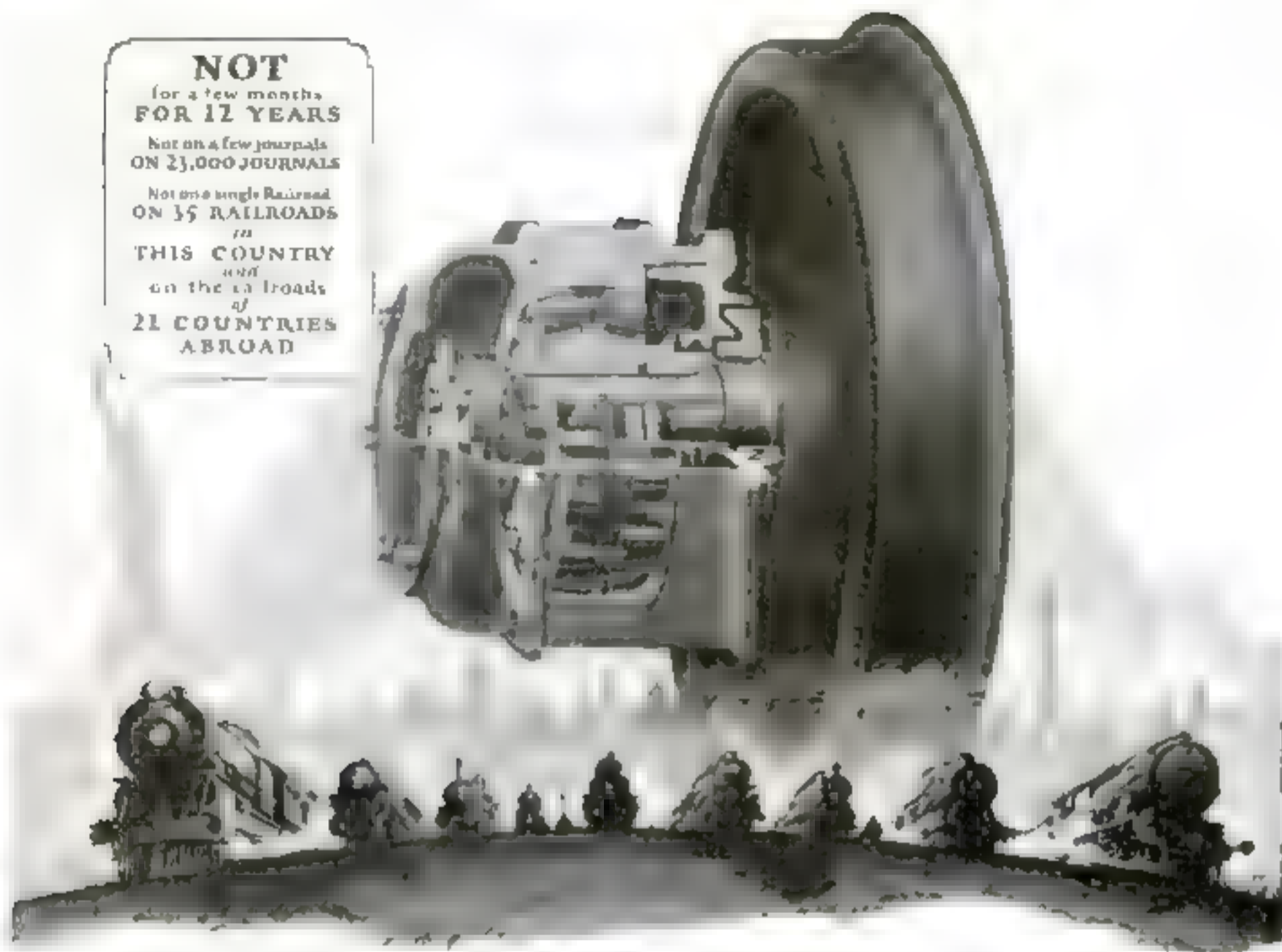
MANY persons seem to feel that their money's worth is fulfilled by a variegated exterior display of numerous substances. A large outside chimney starts with a rubble base and ends with brick, or it combines several varieties of masonry. The first story is brick or near-stone veneer on wood frame. The second story is stucco. Above this a gable end is either clapboard or wood shingled. It would not be surprising if there were two kinds of roof covering, as sheet copper over a little front porch and slate, tile or shingles over the rest of the structure. There are designers who say such

(Continued on page 101)



A charming seven-room brick dwelling designed by Grosvenor Atterbury, whose exterior suggests spacious comfort within. The wide windows, admitting much light, and the great chimneys contribute largely to this homelike effect.

NOT
for a few months
FOR 12 YEARS
Not on a few journals
ON 23,000 JOURNALS
Not on a single Railroad
ON 35 RAILROADS
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of
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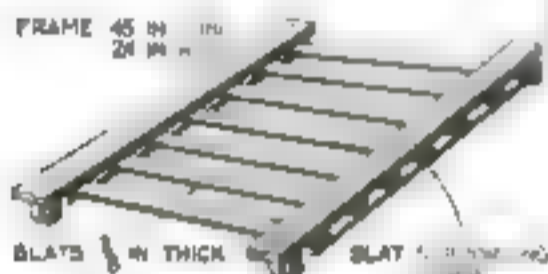
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Valuable Kinks for Your Car

Protector Keeps Starter Switch Clean - Accurate Way To Fill Batteries—Other Ingenious and Useful Ideas

Underslung Auto Creeper

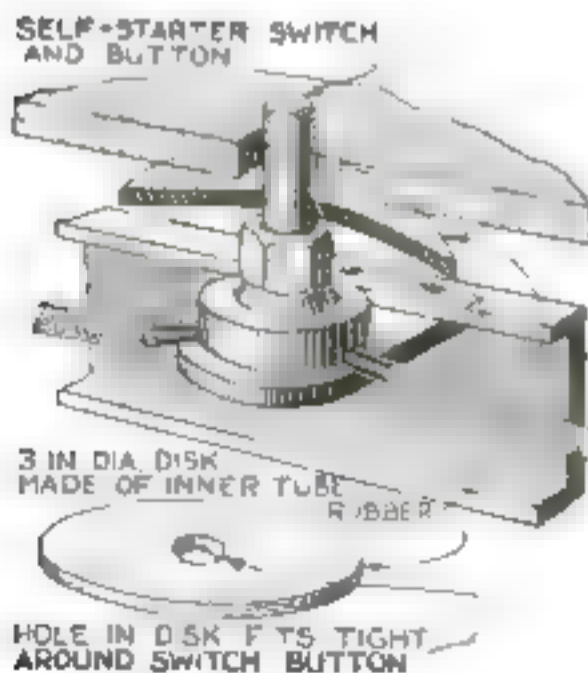
MANY motor car owners hesitate to tackle any job that requires crawling under the car, because, even with overalls, clothes are ruined by the oily slime on the floor. The remedy for this situation is to build yourself a comfortable auto creeper so that you can slide under any part of the car without damaging your clothes, and in a most convenient manner. Modern cars are built so close to the ground that space under them is at a premium. Every inch



counts. The creeper shown in the drawing and illustrated in use is comfortable and affords you maximum working space.

Starter Switch Protector

THE mud brought into your car often works down through the hole around the starter switch plunger and pieces of grit jam it so that it will not work. A simple way to overcome this trouble is to cut a disk of sheet rubber out of an old inner tube and in the center of the disk cut a hole somewhat smaller than the starter switch plunger. Stretch the hole over the plunger as shown in the illustration. Dirt that drops through the hole in the floor board will slide off the rubber shield to the ground without getting into the switch.



In muddy country a rubber disk around the starter switch plunger will keep out the dirt.



This underslung creeper, which is easily made at home makes work under the car a pleasure and gives you as much space as possible to move about.

Ten Dollars for an Idea!

WILLIAM P. MARTIN of Jersey City, N. J., wins the \$10 prize this month for his suggestion of a battery filler. *POPULAR SCIENCE MONTHLY* awards \$10 each month, in addition to regular space rates, to the reader sending in the best idea for motorists. Other contributions that are published on this page are paid for at the usual rates.

Mysterious Ignition Woes

HIGH tension current, such as is employed to produce sparks at the spark plug points in an automobile engine, jumps across the points only when it can find no easier path to travel. Occasionally a cylinder will misfire in a mysterious way, due to an accidental path being provided for the passage of the high tension current. In a heavy rainstorm the motor may start to misfire because a rain drop is now and then flung by the fan onto the side of the spark plug. The moisture bridges over the insulation and the cylinder will misfire until the heat of the plug evaporates the water. If the plugs are covered with a layer of dust and grime, trouble is often experienced in starting a motor that has been left out in the rain for some time, because moisture has condensed on the dust and made it a good path for high tension current. The remedy for that trouble is to keep the exposed part of the insulation wiped clean at all times.

Another source of trouble is old ignition cable. The rubber dries out and cracks and the spark jumps through the crack to the nearest metal. The cable may look all right, but if you lift the hood in the dark you will spot the leak.

Unique Note for Your Horn

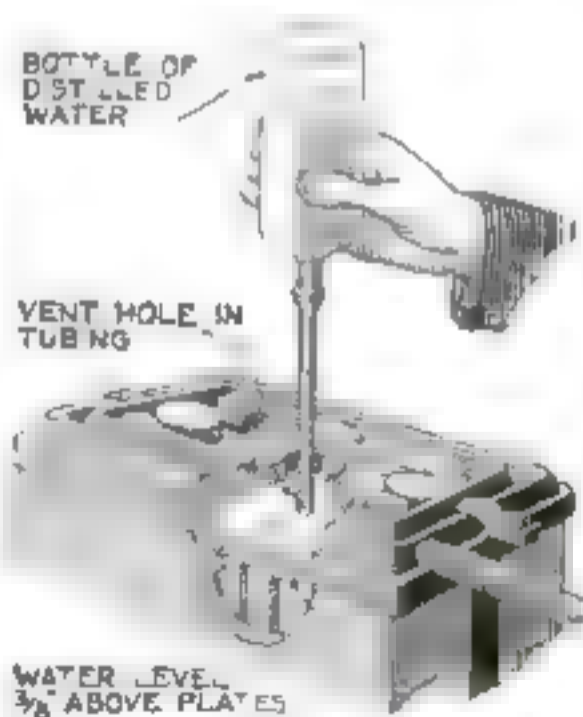
IF YOU are tired of the steady tone of your horn, here is a way to get a warbling effect that will arrest the attention of every pedestrian. The illustration below shows the arrangement. It can be applied to any type of horn, either motor driven or buzzer type. First fit the shaft through the mouth of the horn and to this attach a metal disk just small enough so that it can be revolved. Now fit a large pulley on top of the shaft. This can be made of a circular disk of cigar box wood with a groove whittled in the edge. Attach a small motor to the side of the horn.



A most peculiar warbling note can be obtained by the use of a disk rotated by a small motor. Your horn will command attention on the road.

Automatic Battery Filler

TAKE a bottle of small size and a piece of rubber tube large enough to stretch over the end as shown. Cut a small hole in the side of the tube a distance from the end equal to the height of the battery solution at the maximum point. Squeeze the tube with your fingers, insert it in the battery till it touches the plates, and let go the tube. Water will flow into the battery until the hole is covered.



You can fill each cell of your battery with this simple device without spilling any of the water.

\$8.50

Buy this new twin-blade Trico Cleaner. Any garage can install it, quickly.



This twin-blade cleaner doubles your range of vision..

THESE two blades will change your whole idea of driving. Rain—snow—what do you care when your whole windshield is kept clear as crystal?

The new twin-blade Visionall with its powerful, noiseless suction motor—costs nothing to run. Not connected to your battery.

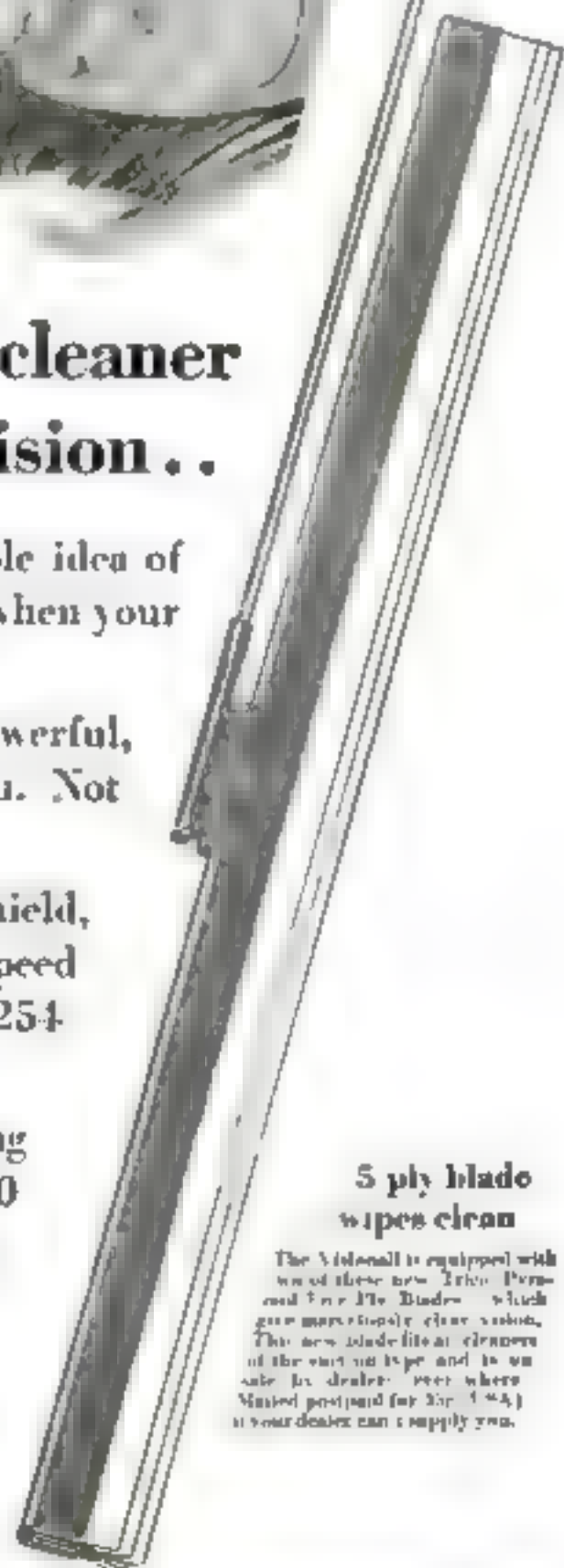
The two blades wipe straight across the windshield, each one cleaning its own half—with the steady speed that cleans to perfection. The cleared area is 254 square inches.

The Visionall is easily, quickly installed, utilizing the same air line as your old cleaner. Price only \$8.50 in U. S. If your dealer can't supply you, we will mail one postpaid for \$8.50. *Made and fully guaranteed by the world's largest manufacturers of windshield equipment.*

TRICO VISIONALL

Automatic Windshield Cleaner

PATENTED U. S. A. AND PRINCIPAL FOREIGN COUNTRIES



5 ply blade wipes clean

The Visionall is equipped with two of these new Trico Perma- and Five Ply Blades which give remarkably clear vision. The new blade like all cleaners of the vision type and is on sale by dealer, see where Visionall is sold for \$8.50 if your dealer can't supply you.

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As advertised in Popular Science Monthly, please send me one Trico Visionall with instructions for installing. I enclose draft or money order for \$8.50.

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Try this Yardstick

on YOUR Brain

MEASURE YOUR KNOWLEDGE with the POPULAR SCIENCE QUESTIONNAIRE

1. Why does radium continue to give out heat for thousands of years?
2. Are the stars solid like the earth?
3. How was the earth formed?
4. Why is glass transparent?
5. How do we know that the earth is slowly shrinking?
6. What is an electric current?
7. How was petroleum formed?
8. Do electrons really move through wire when an electric current is flowing through it?
9. What physical changes in your body are produced by fear?
10. How do muscles exert power?
11. What are X-rays?
12. Can we see stars with a microscope?
13. Why does heat expand things and cold contract them?
14. Why does the moon appear to change its shape from time to time?
15. What is the brain made of?
16. Why is it possible that the inside of the earth is growing hotter instead of colder?
17. Why is frost more likely on a clear night than on a cloudy one?
18. Does thinking use up the thinker's energy?
19. Which travels faster, electricity or light?
20. What simple test will distinguish wool from cotton?
21. What makes the sound of thunder?
22. Why would men ultimately outlive all the green plants were killed?
23. Does the boiling of water remove the impurities in it?
24. How do the living cells of the body get the energy with which to do their work?
25. How is the speed of light measured?

TOTAL PERCENTAGE _____

EVERYBODY is talking about the famous "Popular Science Questionnaire." Doctors, Lawyers, Professors, College Graduates and thousands of others have tested themselves with this Questionnaire. In the panel is the list of questions of which the Questionnaire is composed. How many of them can you answer?

Like an Old-fashioned Examination

May we ask you to make this test carefully, reading the questions slowly and giving thought to each one? When you cannot answer one satisfactorily to yourself, put a zero (0) beside it.

On the other hand, give yourself credit of four (4) for each satisfactory answer. Then when you are through, see how near you have come to making a mark of 100.

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All that you probably ever will want to know about science is told in this one 284-page book that will fit in your pocket or grace a library table. Curiosity-satisfying facts about the world we live in are made instantly available to you in simple question-and-answer form in THE POCKET GUIDE TO SCIENCE.

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Dr. E. E. Free, who has remarkable genius for condensing the known facts about scientific questions into easily remembered paragraphs.

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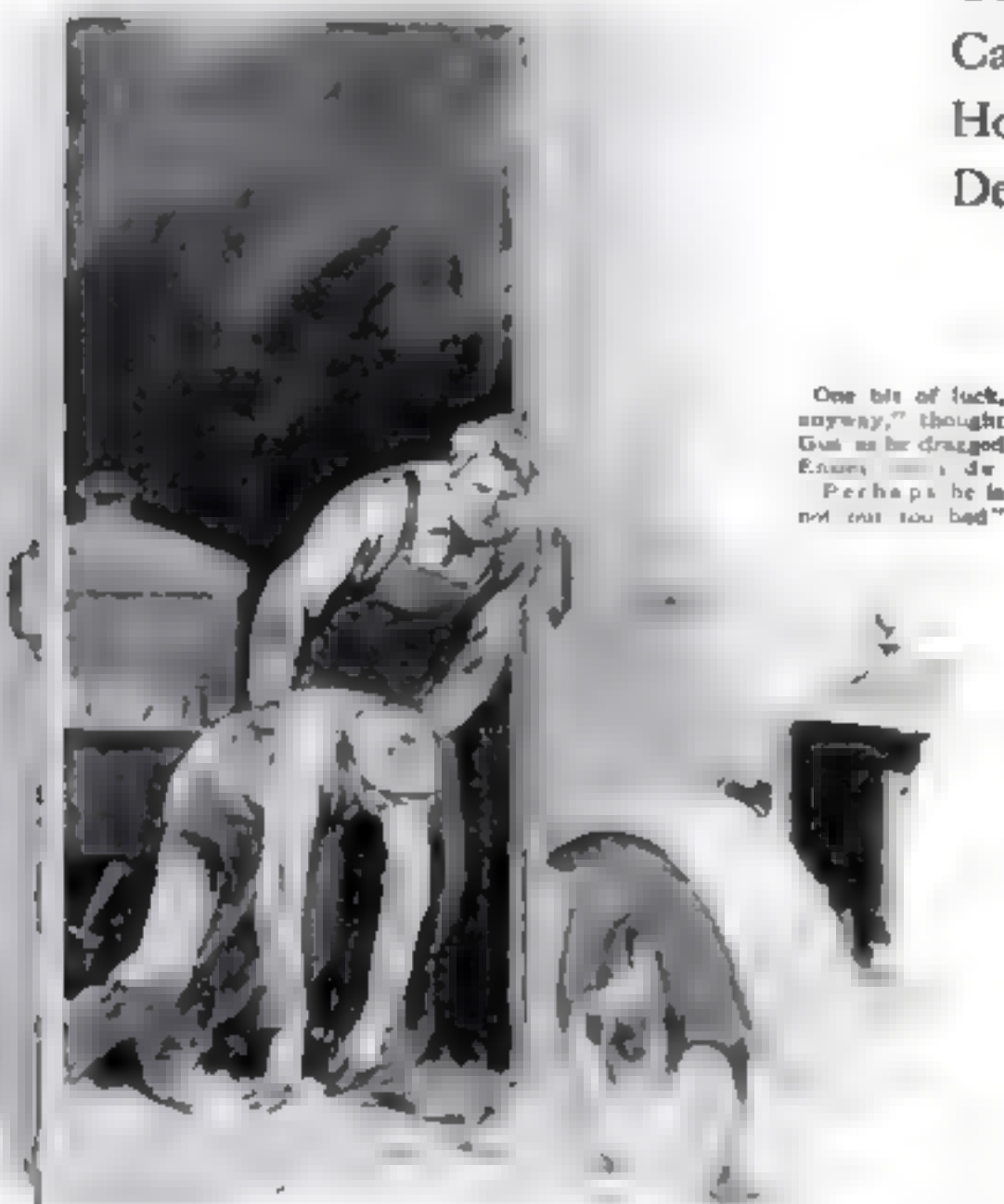
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Death Hides in Your Garage!

Gus Rescues a Victim of Carbon Monoxide, and Tells How to Guard Against This Deadly Peril of Motoring

By MARTIN BUNN



One bit of luck, anyway," thought Gus as he dragged Ensley outside. "Perhaps he is not out too bad."

HY, Joe!" Gus Wilson shouted to his partner in the Model Garage. "What do you think this is, a cold storage plant? My fingers are so cold I can't tell whether I've got hold of a monkey wrench or a screw driver! It's your turn to manure the furnace this week. Get busy before I turn into a hump of ice."

Joe poked his head out of the office. "Goah!" he exclaimed. "It sure is cold out here. I'll tend to it right away." And he headed for the heating plant in the pitlike cellar.

The comforting rumble of the furnace grate reassured Gus, and he picked up his tools to resume work, but just then the telephone rang insistently.

"Drat it!" the veteran motor car mechanic grumbled as he clamped a greasy hand around the receiver and pressed it to his ear.

"Hello, is that you Gus?" inquired a faint voice.

"Right here, John, what can I do for you this cold morning?" said Gus, his frown giving way to a smile as he recognized the voice of John Ensley, a young fellow who had recently started out for himself in the trucking business. Ensley apparently was speaking from his "office" which consisted of a broken-down desk

and a telephone instrument in one corner of his tiny garage.

"There's something wrong with my engine, Gus," Ensley explained. "I had an awful time getting it started and now after it's been run only a little while it's boiling to heat the band. I thought maybe the water was frozen at the bottom of the radiator so I've been running it to get it thawed out, but I just felt the radiator and it's fairly warm right down to the bottom, but still she keeps boiling. What—would you—er—"

The voice trailed off as though the speaker were moving away from the phone, and Gus could hear only the gentle rumbling of the truck motor.

GUS waited a few moments. "Hello!" he called but there was no answer. A startled expression suddenly came over his face.

"By Golly!" he gasped. "It's got him!" And with that cryptic remark Gus slammed the receiver into the hook and tore out of the office as though seven devils were after him.

"Door stuck again?" Joe Clark called casually. He had come up from the furnace in time to see Gus struggling to open the frozen door.

"Shut up and help me," Gus snarled. Their combined weight broke the ice

and Gus dashed quickly toward his car.

"But what's all the hurry about?" Joe demanded. Gus's reply, if he made any, was drowned in the roar of the motor. He shoved the lever into first and a shower of sparks flew from the tire chains on the concrete floor. The car shot out of the garage, skidded on the ice, straightened out, and roared down the road.

Joe watched the departing car in amazement. "Holy smoke!" he gasped. "The old boy's certainly gone nutty!"

The distance to Ensley's was close to three miles over a rutty, ice-covered road. In four minutes Gus roared into Ensley's driveway, slammed on the emergency brake, leaped from his car before it stopped sliding and raced toward the closed garage door.

He swung it open at once and a vast cloud of blue vapor welled out behind it.

GUS darted around the rear of the big truck and there, slumped down beside the old desk, lay Ensley unconscious. Gus's hunch had been right.

"One bit of luck anyway," thought Gus as he dragged Ensley outside. "His face was right close to that hole in the wall and maybe the air coming in diluted the carbon monoxide from the exhaust of the truck enough so that he isn't knocked out too bad."

Evidently no one was home in Ensley's house, for there was no response to Gus's call for help, but he was able to carry the victim through the kitchen door. He placed him on a couch beside an open window and proceeded to apply the usual first aid for suffocation.

Perspiration stood on Gus's forehead before Ensley stirred feebly and opened his eyes. "Where am I? What're you doing here?" he murmured.

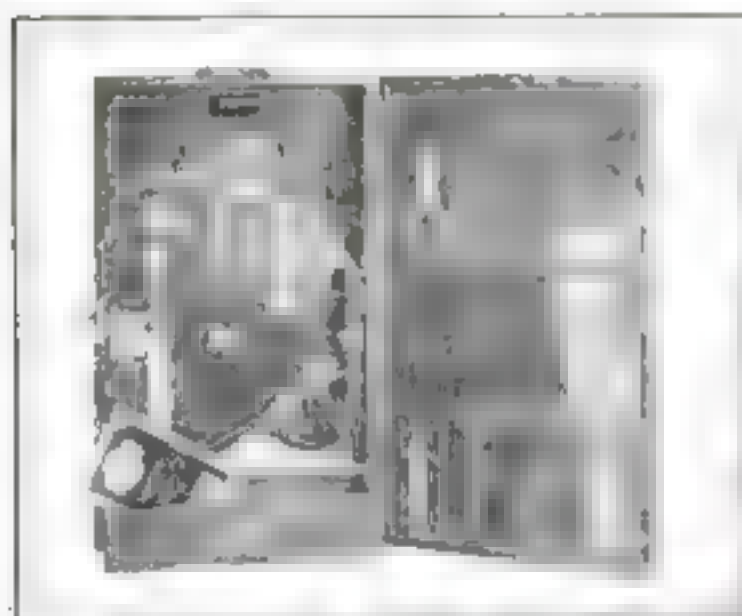
"You came darn near not being here at all, you crazy dumb-bell!" snorted Gus. "You haven't any more sense than a billy goat! Don't you know better than to run a motor with the garage doors closed? You stay quiet now, while I go out and shut off that truck motor."

"Was it still boiling?" Ensley asked weakly when Gus returned.

"Like a teakettle," Gus replied. "What else do you expect when all the blades have been busted off the water pump? The pump must have frozen last night, and when you started it, the ice just naturally sheared off the blades."

"If you feel up to the mark this afternoon, run down to the garage and I'll put in a new pump impeller. Got a lot of work to do—I'll (Continued on page 131)

Buy separately or in assortments



The center table comes to an end!

Make an end table from Plan No. 16e

END tables are now the vogue. To a great extent they have taken the place of center tables. How would you like an end table like the one shown above in your sun parlor, living room or library? Stanley Plan No. 16e gives descriptive drawings and detailed instructions for making this table. For a real evening's relaxation you can't beat making things with tools!



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STANLEY TOOLS



Easy-to-Build Furniture

A Pier Cabinet and Decorative Wall Shelves Anyone Can Nail Together

By HERMAN HJORTH

TO MAKE room for all the books and magazines that accumulate in a small house or apartment is often a difficult problem. It was with this idea in mind that the pier cabinet illustrated on this page and the hanging bookshelves shown on page 97 were designed. These pieces of

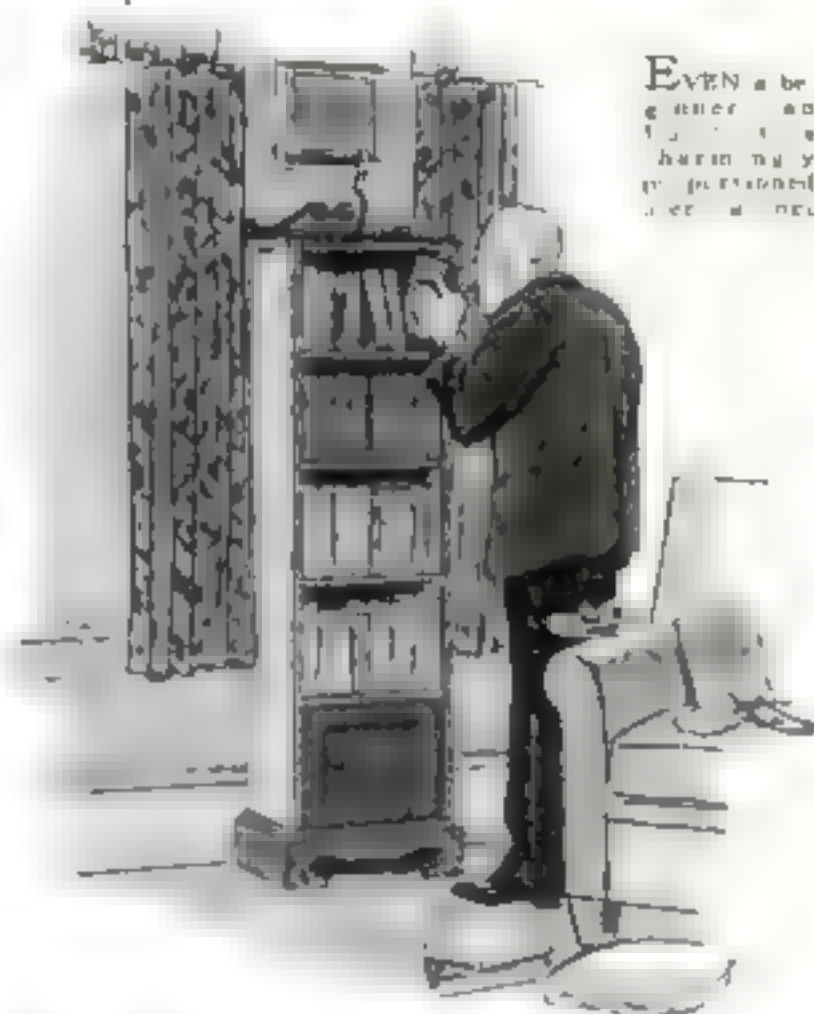
furniture are so narrow that they may occupy a space, as for example between two windows, that is not large enough for the more common types of bookcases.

The construction has been made so simple that a handy man without any training in carpentry or cabinetmaking can build them. At the same time the design is so attractive that anyone will feel the work is worth while from the standpoint of personal satisfaction and the joy of achievement that come with every piece of work well done. And the pieces will represent an actual saving in money effected through a few hours of pleasant and interesting work.

A blueprint has been prepared to show on a larger scale and in much greater detail than is possible in the magazine just how these pieces are made. The blueprint sheet also contains a third design for corner shelves, which are of the same length and general design as the shelves shown on page 97. This sheet, complete with an itemized bill of materials, a list of tools and a suggested order of operations, can be obtained by sending 25 cents to the Blueprint Service Department of POPULAR SCIENCE MONTHLY, 250 Fourth Avenue, New York (see page 102).

IF THE pieces are to be finished in colored brushing lacquer, which is the most popular treatment at present, some fine-grained, easily-worked wood such as white pine or whitewood may be used.

The first operation in constructing the



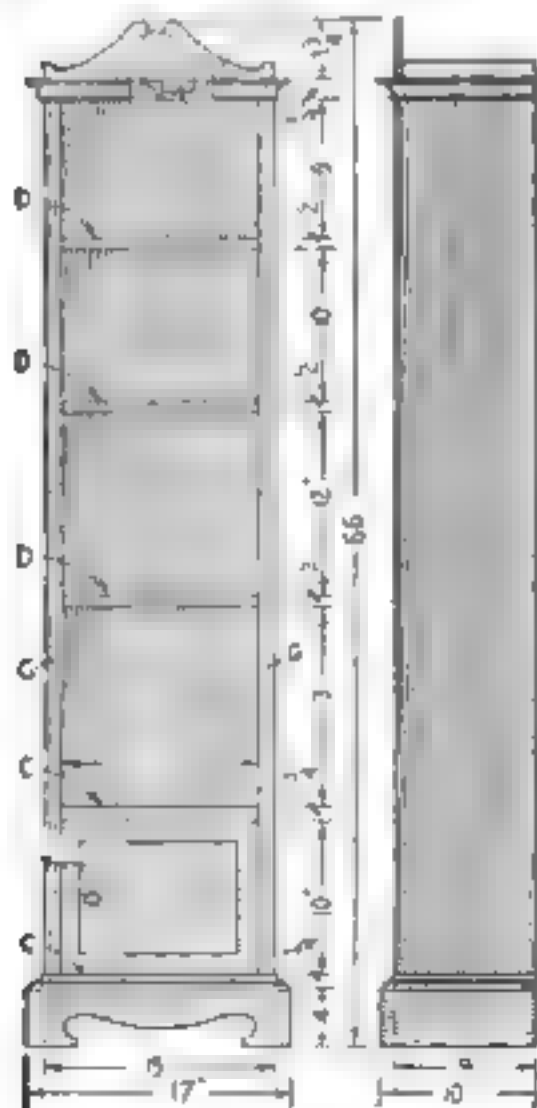
Modern pier cabinets, of which this is such a well-designed example, are especially popular because they require little wall and floor space. If it is desired to use the top shelf for statuary or pottery, the ornamental piece shown in the drawing in the first column may be omitted or placed at the back of the case instead of the front.

pier cabinet is to make two ladder-shaped frames for the ends. Each of these consists of two pieces of wood $3\frac{1}{2}$ by 1 by 61 $\frac{1}{4}$ in. and five pieces $3\frac{1}{2}$ by 1 by 8 $\frac{1}{4}$ in. The shorter pieces are nailed between the uprights in such positions as to support the bottom and the shelves.

THREE pieces $3\frac{1}{2}$ by 8 $\frac{1}{4}$ by 14 $\frac{1}{4}$ in. are cut to make the shelves and top marked C, and three pieces $3\frac{1}{2}$ by 8 $\frac{1}{4}$ by 14 $\frac{1}{4}$ in. to form the shelves D. Before the frames and shelves can be assembled, it is necessary to notch the shelves at the corners to suit the upright members of the frame. This is a simple matter; a glance at the drawing on Blueprint No. 77 that shows the partly assembled cabinet will indicate just what is necessary. All the shelves and the top come flush with the frames on the sides and back, and the three marked D also come flush with the front of the frames. The two lower shelves and also the top, which are marked C, project $\frac{1}{4}$ in. beyond the front of the frames.

After securely nailing the shelves to the side frames and planing off any slight unevenness of

(Continued on page 96)



Front and side views of the cabinet, which indicate the simplicity of construction

How to Make Radiator Covers

They Partly Conceal the Ugly Heating Coils and Save the Window Draperies from Being Bombarded with Dust

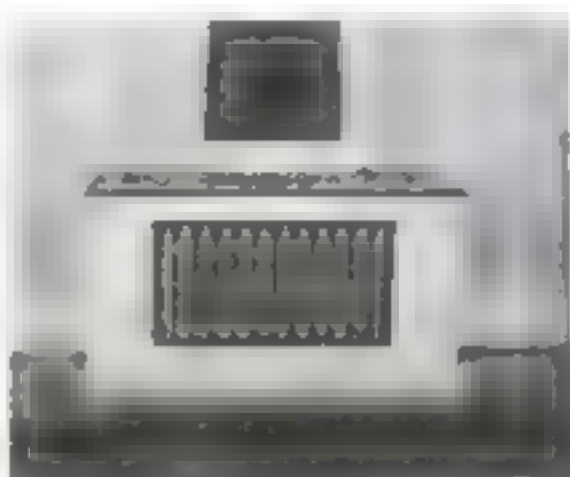
By FAYRETT EAMES

PRESENT DAY fashions in house heating equipment dictate that the radiator be wholly or partly concealed. When its covering is finished to harmonize with the woodwork and furniture of the room, it becomes a decoration instead of a clumsy piece of heating apparatus. A practical feature, too, is that the warm air is directed outward and away from the curtains, which are no longer continually bombarded with dust particles. This prevents their discoloration and the frequent need of laundering them.

It is not necessary that radiator covers be of expensive metal construction. They may be made of wood if an auxiliary metal and asbestos heat deflector is used. Special but easily taken precautions, however, are necessary to prevent the wood from becoming badly warped.

Pine or other more resistant timber is not suitable because the pitch may come out or at least discolor the paint. The best wood perhaps is kiln-dried maple, for once thoroughly dried and painted this wood is not apt to warp or shrink. It is quite expensive, however, and a good substitute is whitewood. While this wood will shrink somewhat, the effect can be nullified by paneling the ends of the cover with an overlay of $\frac{3}{4}$ -in. basswood. The hardwood should be dried for several weeks even if it has previously come from a kiln.

If the radiator does not extend the full



A cheaply built but attractive cover for a radiator narrower than the window sill.

radiator or for adjusting or packing the steam or air valves. It is desirable to conceal the steam valve, but as it is occasionally necessary to open or close it, a little trap door with spring hinges on the inside is placed at one end of the cover. This may be cut out so neatly with a fret saw that the piece removed may be used as the door, which when closed will be only slightly visible.

AS A guide to proper proportions, the dimensions of one cover have been given, but it should be borne in mind that they apply only to a particular radiator and window. Note the baseboard that was added to give the cover something to rest on and lend a more finished appearance.

When assembling the parts, the top and sides should be drilled and countersunk for wood screws, which should be placed not more than 6 in. apart. These screws will prevent the sides and top from warping and pulling out the brads that would be used if this were an ordinary cabinet job. Place the heads of the screws $\frac{1}{4}$ in. below the surface and conceal with dowel pins or plugs, sanded smooth. This deep countersinking may be accomplished by the use of a drill the same size as the head of the screw.

In some cases the pipe leading from the steam valve into the radiator must be straddled. This is easily accomplished by cutting out a U-shaped piece with a fret saw.

The end paneling is all made by carefully fitting the $\frac{3}{4}$ -in. basswood strips to form a hollow rectangle. The strips may be either beveled or simply rounded on the inner edges to give a more finished

effect. The cove molding is placed on one edge until it is the same thickness as the basswood strips. All the trim is glued and fastened with countersink brads.

To make the heat deflector, two sheets of tin of sufficient size to enclose the back and top of the radiator should be obtained. Between them should be placed two layers of $\frac{1}{2}$ -in. sheet asbestos. The latter being cut so that a $\frac{1}{2}$ -in. margin is left on all sides. The assembled tin and asbestos should be drilled and riveted with small copper rivets. The assistance of a tinsmith is desirable in fashioning the deflector on account of the special tools he has available. In order to avoid wrinkles in the inner side of the curve, the rivets should be left out of the upper edge until the bend has been made. The completed deflector should be painted to match the radiator.

As the interior finish of many homes is cream-colored enamel with much mahogany or walnut furniture about, a practical and harmonizing color scheme is obtained by staining the top of the cover mahogany or walnut and painting the sides to match the woodwork.

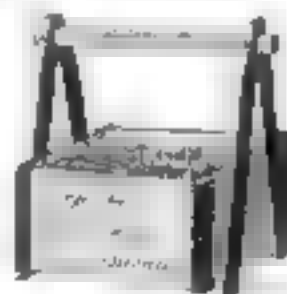
In staining, the manufacturer's directions should be followed. When painting, one coat of white lead followed by a coat of shellac and two coats of interior flat house paint may be applied. Sandpaper each coat after it has dried. The final coat should be enamel of the desired tint. It will be found that whitewood takes both stain and paint readily.

As will be seen from the photograph, the radiator sections form a rather pleasing design when partly concealed by the cover; if a more finished effect is desired, a section of metal grill may be set in the opening. Grillwork may be obtained from radiator manufacturers.

Portable Kindling Boxes

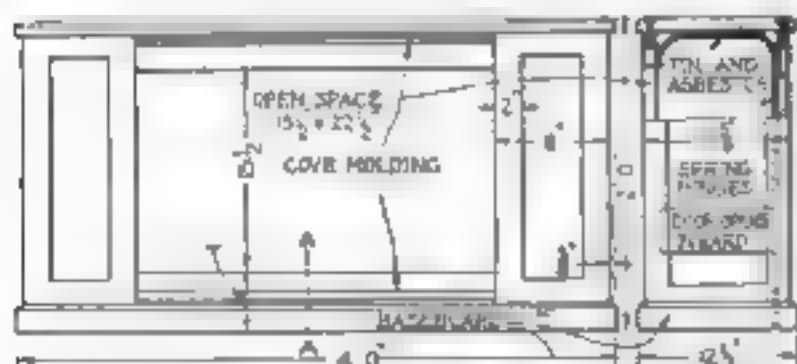
THE kindling box or fuel carrier illustrated (of course it may serve for other purposes, or be provided with a lid or otherwise altered) was

made from a discarded plywood packing box. An empty apple or soap box might do as well. The corners were reinforced with aluminum binding salvaged from the junk



Fuel carrier made of packing boxes.

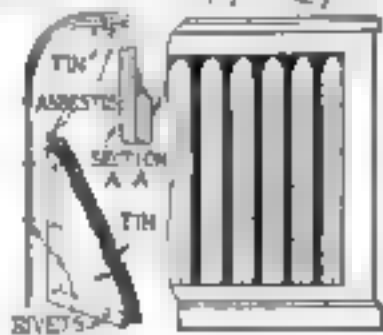
pile of an auto repair shop. These strips were fastened with clutch rivets such as are used for auto brake bands. The legs and handle were made from another packing box.—GEORGE D. HUGO.



How a typical radiator cover is made: details of the reflector an alternative design without end panels.

width of a window, the cover should be built out and the ends paneled as shown in the accompanying photograph and one of the drawings. If the radiator is the full width of the window, the end construction is as suggested in another of the drawings.

The actual building of the cover is by the cut-and-try method. A close fit should be aimed at, as the cover is not fastened in place. It is so made that it may be lifted off for dusting out the



Modern Ways to Paint Chairs

How to Decorate Unfinished or Old-Fashioned Seats in the Artistic Color Schemes That Are Now the Vogue

By BERTON ELLIOT

IN EVERY room there is usually some place where an odd chair in just the right color treatment would add much to the attractiveness. By the same token, there are usually in every home one or more chairs of good design and solid construction that are of undesirable finish or so badly worn that they have been relegated to the attic. Here is an opportunity for the home craftsman to reclaim a chair by decorating it to suit its setting. And if no old chair is available, a new one can be bought unfinished or "in the white," as the saying goes.

Decide first the colors to use. Consider whether the chair should be in subdued tones, blending unobtrusively with the other furnishings, or in bright and daring hues. The color scheme determined, consider next the treatment. This, of course, will depend somewhat upon the design of the chair. Several methods are illustrated, one of which may be suitable for the chair you have. If not, they will suggest ways in which you can work out individual ideas. Sometimes, too, you will see in a shop window or store an appropriate scheme which can be copied or adapted to your own use.

THE four treatments shown in the accompanying illustrations can be carried out in a variety of color schemes, some of which are suggested in the following paragraphs. Chairs of the type shown in Figs. 1 and 4 may be purchased unpainted in practically all large department stores and furniture shops.

A Windsor chair (Fig. 1), with its pleasing lines, has a way of fitting in and looking well wherever it is put. It allows the most interesting color treatment. Seat, curved frame and spokes may be in one color with the edge of the seat and the turnings on the

legs in a trim color. Black, trimmed with Indian yellow, Chinese red trimmed with black, and twilight blue trimmed with orange are all good, bright color schemes, while lettuce green and cream, or ivory and sage gray, provide color arrangements of a conservative type.

The same chair could have its seat, curved frame and legs in one color, and the edge of the seat and spokes in either a harmonizing or contrasting tone. In lettuce green, trimmed with gold or cream, this would be a most effective treatment. Ivory trimmed with apricot is another pleasing, dainty combination, while an effect of unusual richness would be Italian blue for the predominating color



Fig. 1. A Windsor chair with trimming color on edge of seat, leg turnings and back.

and gold for trimming.

The fact that a chair was originally one of a set or intended for some special use, as in a bedroom, does not prevent its being refinished in bright, dainty or subtle colors, as may be preferred. The upholstery, if any,

must be taken into consideration in choosing the colors, as suggested in Fig. 2. Another attractive color scheme would be delft blue trimmed with rose and gold. Two-tone effects, such as modas green trimmed with jade green, are especially pretty for a chair of this kind.

No chair is too high class for a "painted" finish, if well done. In Fig. 3 is shown a high priced rocker fit to grace the drawing room of the most fastidious. In putty color with the right tones of green and gold color, it would be an exquisite piece. Black striped with touches of Chinese red and with a conventional design is often a good choice for furniture that is upholstered in bright, daring colors.

Figure 4 illustrates the possibil-

ities for the artistic decoration of the common kitchen chair. With the widespread vogue for color, this lowly piece of furniture has been dressed up in most pleasing combinations. Thousands of such chairs have been transformed by home craftsmen into delightful breakfast furniture, or made to en-



Fig. 4. Common kitchen chairs are easily transformed by the magic of happily chosen and attractive color schemes.

liven and bring cheer into the everyday life of the kitchen. Besides the color treatment shown, ivory trimmed with jade green, turquoise blue or apricot is very attractive, the seats, spokes and legs being in the ivory, and the curved frame, edge of seat, and turnings in the trim color. The methods of treatment suggested for Windsor chairs would also be quite appropriate for a kitchen chair.

The refinishing may be done directly over the old finish either in brushing lacquer or enamel.

First clean the chair thoroughly with soap and water, and rinse off with clear water. Then wipe the surface with a cloth saturated with gasoline or benzene to insure freedom from grease or wax deposits, which are often fatal to good results in the use of painting materials. Next sandpaper the surface enough to cut the gloss and dust off all loose particles.

FOR a lacquered finish, apply two or three coats as may be necessary to produce a good finish, without sandpapering between coats.

For an enamel finish, apply two coats of flat undercoater, followed by one coat of enamel for a three-coat job, or by one coat of equal parts undercoater and enamel and one coat of straight enamel for a four-coat job. Sandpaper between all coats.

(Continued on page 88)



Fig. 2. By the use of brushing lacquer and a new covering for the seat, this old chair was converted into a distinctly modern piece.

At Last—The True "Santa Maria"

Our Blueprints Will Help You Build an Authentic and Unusually Beautiful Model of the Flagship of Columbus

By E. ARMITAGE McCANN

LAST month we made out a small scale the hull of a Santa Maria such as Christopher Columbus must have used. This model it has been shown, is quite different from the vessel sent to the Columbian Exposition, which, although it is more like a seventeenth century carack, has been reproduced everywhere as an authentic fifteenth century vessel. The difference from now on will be even more marked, as we proceed to erect the superstructure.

If you missed the first article last month, it need not prevent your starting work on the model now. You can obtain three blueprints with full size drawings of the hull, rigging and small parts and a list of the materials from the Blueprint Service Department of Popular Science Monthly, 250 Fourth Avenue, New York. Use the coupon on page 102, where the blueprints are listed as Nos. 74, 75 and 76. As long as a supply is available, you can also obtain a copy of the December issue, with the first article, by sending 25 cents to either the Blueprint Service Department or the Circulation Department.

THE forecastle is a platform resting on timbers that are bolted to the fore part of the hull and project over the stem. To make it correctly, first nail to the hull two strips of wood $\frac{3}{4}$ in. thick, $\frac{1}{2}$ in. wide and $4\frac{1}{2}$ in. long with their centers $2\frac{1}{2}$ in. apart at the after edge and $\frac{1}{4}$ in. apart at the fore ends. Nail other pieces from the extreme after corners, beveled to meet the first pieces at the fore ends. Across these lay five smaller battens at equal distances, except that there must be room between the second and third for



Captain McCann puts the finishing touches on the hull of his own exhibition model of the ship, which he made half as large again as that shown on our Blueprints Nos. 74, 75 and 76

the mast and bowsprit holes. The ends, which will be cut off square, will project slightly beyond the side timbers.

To the size and shape of this triangular support, cut a thin piece of wood, such as from a cigar box. Secure it to represent deck planks and cut a round hole for the mast and a square one for the bowsprit, as shown in the drawing below. Cut five other pieces of wood not more than $\frac{3}{4}$ in. thick and $\frac{1}{2}$ in. wide to go around this, with the exception of a $1\frac{1}{2}$ in. gap in the

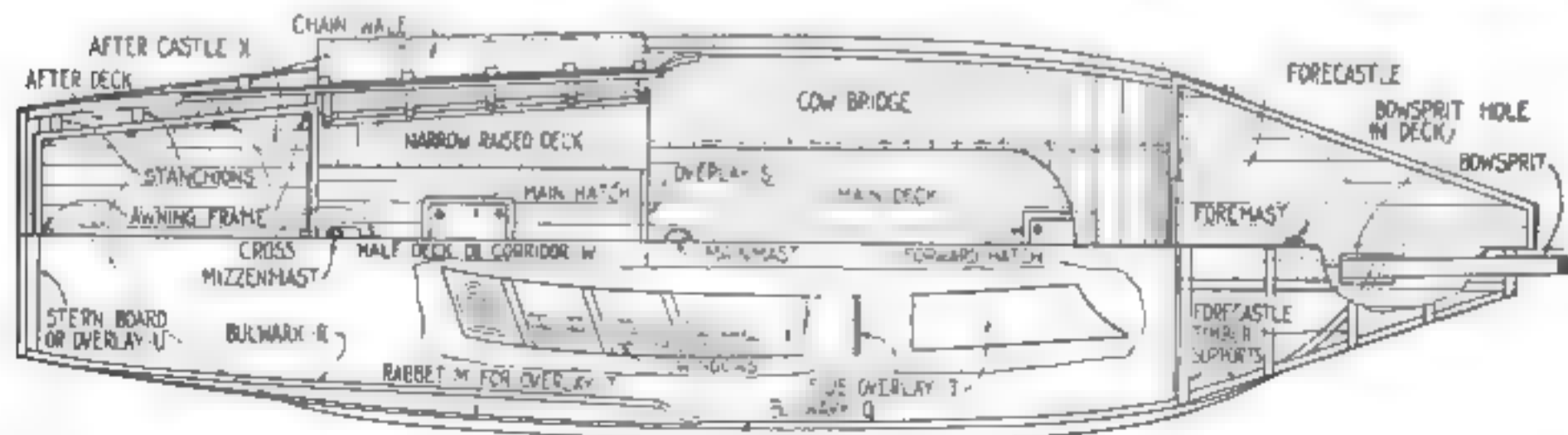
middle of the after part. Along the two sides and after ends bore two rows of holes at equal distances apart and of a full $\frac{3}{4}$ in. diameter. These are for the protection of the archers or musketeers. Nail and glue these to the platform with watered or square corners. Along them glue three $\frac{3}{8}$ -in. moldings. On the front end there may be an ornament, such as a fancy upholstery nail.

Stain the supporting timbers dark brown and the rest light brown inside, paint the outside with cerulean (sky) blue, but not too brightly. After the blue has been applied, rub a little green and Vandyke brown into it.

ON THE after deck first make the corridor or half deck (W). Make ten strips $1\frac{1}{2}$ in. long, ten 1 in. long and eight $4\frac{1}{2}$ in. long, all $\frac{1}{2}$ in. square in cross section. Lay two of the long pieces $\frac{1}{2}$ in. apart and with $\frac{3}{8}$ -in. pins nail five $1\frac{1}{2}$ -in. pieces to them at equal distances. Nail the lower ends of these uprights to the inside of the bulwarks. Fasten one of the strips to the deck with its midship edge $1\frac{1}{2}$ in. from the bulwark at the fore end and the whole parallel to the center line of the vessel to a fourth strip nail the ends of the shortest pieces, and nail their lower ends to the deck strips. To fit on this superstructure, lay a thin deck with the grain athwart and the planks marked. Do the same for the other side and steady the two with a strip across the whole at the after end. Note that the long pieces follow the line of the sheer, and the uprights slope slightly aft.

The after castle (X) is of the same construction as the forward one, but rests on ten curved

(Continued on page 84)



Deck view of the model, which should be compared carefully with the illustrations on page 94, and a detail of the side overlays. All the essential draw-

ings for constructing the model appear full size on the blueprints, which you should obtain before starting work. They will save you much time and effort

This Advertisement Is Not Intended to Sell ~ ~ ~ Merely to Inform

The Truth about Radio

This advertising is not necessary from a selling standpoint as the entire current production of the great Freed-Eisemann plant is spoken for by its authorized dealers. Most advertising is intended to sell. This advertisement is intended to inform and we take this opportunity to tell the radio public that whatever radio set is bought the following elements should be sought for before investing in any radio. Tear out this page and ask your dealer to answer for you the following questions before deciding on any set.

Keep this page as Your Guide in Buying any Set

How Can I Tell the Latest Type of Electric Set from So-Called "Electrified" Sets?

Ask the dealer whether it gets its power direct from the electric light socket through the new 226 and 227 AC tubes.

What Type of Radio Is Demanded by Those Who Have Used Sets for Several Years?

It is built by the manufacturer, complete, ready to plug into the light socket. No auxiliary power supply units are to be purchased.

It has a single tuning control.

It has tone quality, so faithful that you can close your eyes and imagine that a singer is actually in the room.

Will Storage Battery Operated Sets Be Obsolete?

No. Battery sets, or so-called "electrified" sets (not using the new AC tubes) will continue to be used where the following conditions prevail:

1. Where alternating house lighting current is not available.
2. Where the current fluctuates, such as in districts where the current supply from the power house is insufficient to supply the growing community without fluctuation, as when the evening load is applied.
3. In homes lighted by farm lighting plants.
4. Where direct current is used.

(Phone your electric light company for this information.)

Must I Wait to Get Delivery of a Good Electric Set?

Possibly; the demand for some makes is greater than the supply. The reason is that the public has become radio-wise and insists on the most modern improved instrument.

How Can I Tell Whether Any Given Set Delivers the Best Tone Quality for the Money?

Insist on a competitive demonstration between various makes.

And What About My Old Set?

Just like automobiles, some sets have a higher trade-in value than others. The second-hand value is regulated by the public

demand. Sets of well-known makers with reputations for building high quality instruments, command better trade-in values than others without such reputations.

Remember a Modern Radio has these Elements—

1—Obtains all its power from the house lighting current supply and utilizes the new AC vacuum tubes, types 226 and 227.

2—The modern radio is self-contained, that is everything except the Loud Speaker is enclosed in a single cabinet. There are no wires leading to a power unit standing on the floor. The modern radio is completely housed in its own cabinet.

3—No batteries of any kind; no liquids, no acids.

4—Individual compartment shielding.

5—Two large heavy audio transformers with output transformer.

6—Single tuning window with illuminated scale.

7—Inductor in the antenna circuit to insure increased amplification on high wavelengths.

8—Patent rights enabling freedom in design.

In General, How Can I Guide Myself in Selecting a Particular Make?

Be sure that the set you buy has all the latest inventions. Inquire regarding each of the points mentioned in this advertisement.

Why Are Some Radios More Heavily Advertised Than Others?

The answer is simple. No high-pressure sales methods are needed to sell sets that have an insistent demand through word-of-mouth advertising.

What About Next Year?

Electric radio is now standard. The set with power equipment built in by the manufacturer is the best word. Your investment is permanent.

Of Two Equally Good Makes, Why Does One Cost More Than Another?

The answer lies in the productive capacity of the factory. Large production means low cost. A small production necessitates a higher retail selling price.

What Is All This About Patents?

Patent rights must be respected. Some radio manufacturers have rights under all important patents. Others cannot put the latest and most important inventions into their apparatus.

What About Loud Speakers?

Most manufacturers build loud speakers designed to operate most efficiently with their own sets. If you buy a radio, buy a speaker built by the same maker.

Why Are Some Stores Unable to Supply Certain Makes of Radio Sets?

The manufacturer whose sets are in great demand gives the selling agency only to certain stores in each locality. The retail selling franchise for such sets is eagerly sought by dealers but sparingly given only to selected dealers.

Will the Dealer Make Demonstration in My Own Home?

Yes. Ask him. With an electric set, he can do so with very little trouble as he need not carry batteries or auxiliary power devices. Most good dealers will make a home demonstration without any obligation on your part.

Can I Buy a Radio in a Cabinet Suitable for My Home?

Most makers supply so-called table model sets and also a wide supply of cabinets of varied styles for your choice, into which the electric radio can be mounted.

FREED-EISEMANN RADIO

Brooklyn

Manufactured under patents of Loebel, Friedman, Radio Corp., General Electric, Westinghouse, American Telephone & Telegraph Co.

New York

ASK Any One of Half a Million USERS

In Your Own Workshop You Can Turn Cheap Barn Door Hinges into Hand-Wrought Hardware

By F. N. VANDERWALKER

NINE dollars a pair was the price asked for the hinges that the writer wished to mount on a desk made of odds and ends of lumber. Cheaper hinges were to be bought, it is true, but the commonplace, machine-made scrolls and curls would not do at all. It was quite apparent that only hand-wrought hardware of the finest craftsmanship would be satisfactory, and, as the writer is a natural born tinker by avocation, although a painter and decorator by vocation, he found how to get what he wanted out of—don't laugh—four common, cheap barn door hinges.

The decoration of the wooden parts of the desk consisted of light pea green ground coats with a glaze stain on top, wiped in streaks for antique effect and finished with two coats of clear lacquer. Inside, the ground coats were the same, but the glaze coat was red and mottled in a clouded effect instead of streaked.

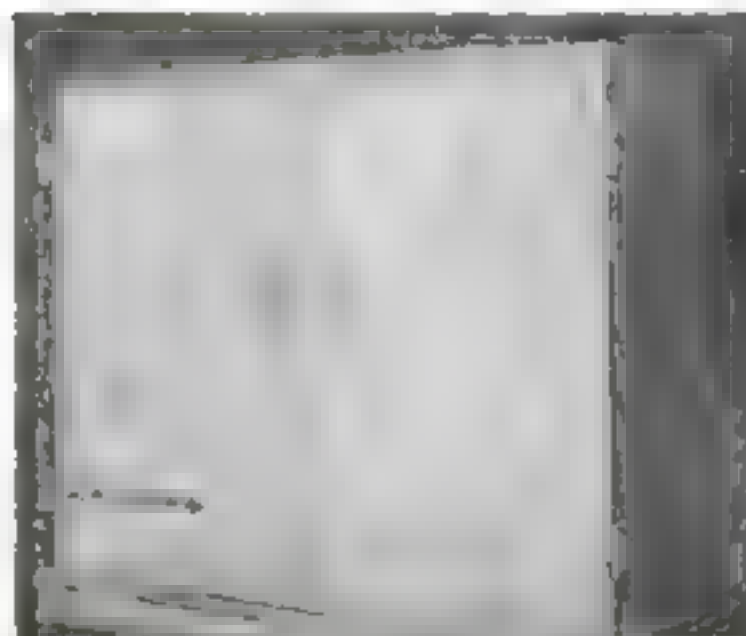
The first step toward getting the hinges was to determine about how long they should be for the width of the doors. Next, a few rough pencil sketches were made and a satisfactory design was drawn on cardboard and cut out with a knife.

A visit to the hardware store soon located four black iron barn hinges of the strap type which were large enough $2\frac{1}{4}$ in. wide at the pin and $10\frac{1}{2}$ in. long when doubled up.

The cardboard pattern was placed on the back of one of the hinges and the outline traced with a soapstone marking pencil. The hinge was placed on an 8-in. section of railroad rail any heavy piece of iron would have done—and with hammer and cold chisel the major part of the surplus metal was cut away. A hack saw, too, was used here and there. Then the hinge was put in a vise and filed down true to the line. The remaining hinges were similarly treated.

WITH a machinist's ball pin hammer, such as comes with an automobile tool kit, the surface of the hinge was hammered pretty thoroughly. After this battering it was found necessary to pound the steel out flat again, because it had curled up slightly.

The holes in the hinges were not properly located to look well in the new design; consequently, the unwanted holes were cleaned out, coated with a little soldering acid (muriatic acid in which a piece of zinc metal had been placed) and



At left: The work on the hinge is done with a hammer and chisel. The hinge is being worked on a piece of steel plate.

At right: After the work on the hinge is done, the hinge is being worked on a piece of steel plate. The hinge is being worked on a piece of steel plate.



The barn door hinge as purchased and after being it moved to a new and more set size outline.

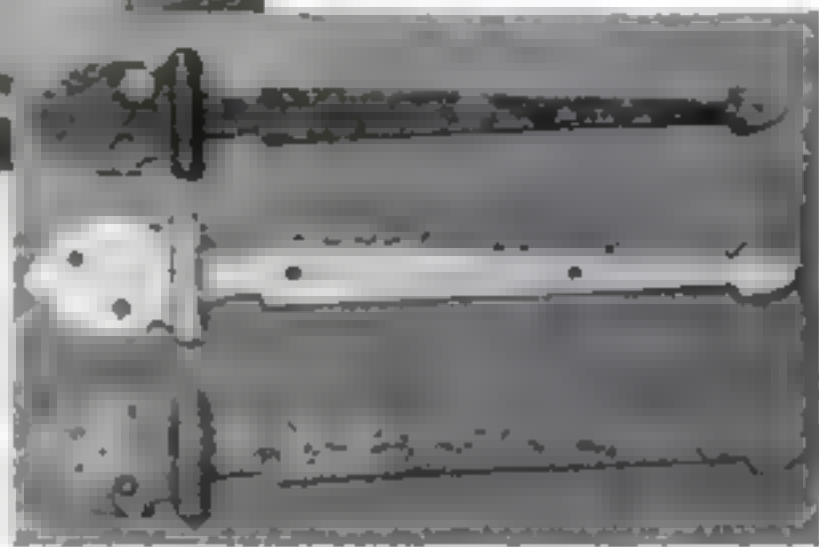
filled with solder. When cold, the solder was hammered to the same appearance as the surrounding surface. New holes were drilled to be properly balanced in the design and the hinge was cleaned up with steel wool or sandpaper and given a bath of gasoline to remove all oil. It was then ready to be decorated.

A coat of gray paint was put on as a foundation. In this case it happened to be white lead thinned with turpentine so it would dry flat. The finish wanted was the bright steel effect noted on the armor of knight-hood days. It could have been gained a bit less effectively by simply polishing the steel with sandpaper and fine steel wool, then varnishing, or better yet, using clear brushing lacquer upon it. The lacquer is more transparent than varnish.

For a brighter effect than could be gained simply by polishing the steel, the writer put on the paint coat, let it dry and then covered the surface with real silver leaf. Sounds expensive, but it is

not. The silver leaf is very thin and a book containing twenty-four sheets of it will cost about the same as a book containing ten sheets of it. A book containing ten sheets of it will cost about the same as a book containing five sheets of it. A book containing five sheets of it will cost about the same as a book containing two sheets of it. A book containing two sheets of it will cost about the same as a book containing one sheet of it. A book containing one sheet of it will cost about the same as a book containing no sheets of it.

The next step requires a can of flat black paint; or get a pound can or a tube of black ground—(Continued on page 100)



finger away. Then the leaf may be put on.

For a job like this, which requires narrow strips of leaf, it is best to cut out of the book with shears four or five of the paper pages at a time, cutting the leaf with the pages. Then lift one paper page with the leaf on it and lay it, leaf side down, on the sticky gold size. With a camel's-hair or other soft brush an inch or less wide, smooth out the leaf and press it down by brushing on top of the paper page. Pull off the paper and gently brush down any loose edges of leaf. Apply the next leaf in the same way, letting it overlap the first sheet a little. The gold size with leaf attached should be allowed to dry overnight and then, after brushing off the loose overlapping leaf edges, coat the surface with clear brushing lacquer, which will dry in an hour and be ready for the next operation. Instead of using silver or aluminum leaf, you can use aluminum bronze with the usual bronzing liquid, or the dry bronze powder mixed into clear lacquer. The finish will not be quite so light in color, however. The leaf metals, bronze powders, gold size japan and bronzing liquids can be purchased at art stores and at painters' supply houses.

The next step requires a can of flat black paint; or get a pound can or a tube of black ground—(Continued on page 100)



PICK YOUR PEN POINT BY COLOR

The simplest, safest, surest way to get permanent pen satisfaction is to pick your pen point by color.

Waterman's Number Seven

with its identifying color band offers the quickest, most reliable guide to pen point selection

The following colors on holders tell the story of pen point character. Look for them on Waterman's Number Seven.

Red—STANDARD—Suits most writers. A splendid correspondence point. Medium flexibility. For home and general use.

Green—RIGID—Tempered to armor-plate hardness. Will not shade even under heavy pressure. Unequaled for bookbinding. The colorman's friend.

Purple—STIFF, FINE—Writes without pressure. Makes a thin, clear line and small figures with unerring accuracy. Popular with accountants.

Pink—FLEXIBLE, FINE—As resilient as a watch-spring. Fine, tapered point; ground fine to shade at any angle. Loved by stenographers.

Blue—BLUNT—An improved stub point. This point makes a broad line. May be held in any position. Liked by rapid writers.

Yellow—ROUNDED—A different pen point. The tip is ball shape. Makes a heavy, characteristic line without pressure. Suits left-handed writers.

Merchants who sell Waterman's will be glad to let you try all six points. Do this and select the one that suits you best.

When you buy a Waterman's you buy perpetual pen service.

Guaranteed since 1883 and until 1983—100 years of pen service

L. E. Waterman Company
191 Broadway, New York

CHICAGO

BOSTON

SAN FRANCISCO

MONTREAL



\$7.00

Number Seven

Beautiful, resilient
Ripple stainless rubber holder.
Made with protective lip-guard
and an unequalled patented filling
device.

Waterman's

Office heat... chilly street... sore throat!

From over-heated offices into chilly streets... out in the cold waiting for transportation... into germ laden cars crowded with coughers... is it any wonder thousands are laid up with colds or sore throats—or worse?

Don't be one of them. After exposure of this kind, gargle with Listerine when you get home.

Better yet, use it systematically night and morning during nasty weather. It may be the means of sparing you a long, painful and costly siege of illness. Many a cold weather complaint has been checked by Listerine before it had a chance to become serious.

Being antiseptic, it immediately attacks the countless disease-producing germs that

lodge in mouth, nose and throat.

Again, we counsel you for your own protection to use this safe antiseptic twice a day, at least, during inclement weather. Lambert Pharmacal Company, St. Louis, Mo., U. S. A.

Gargle when you get home



In the **THROAT**
and nose more
than
50 diseases

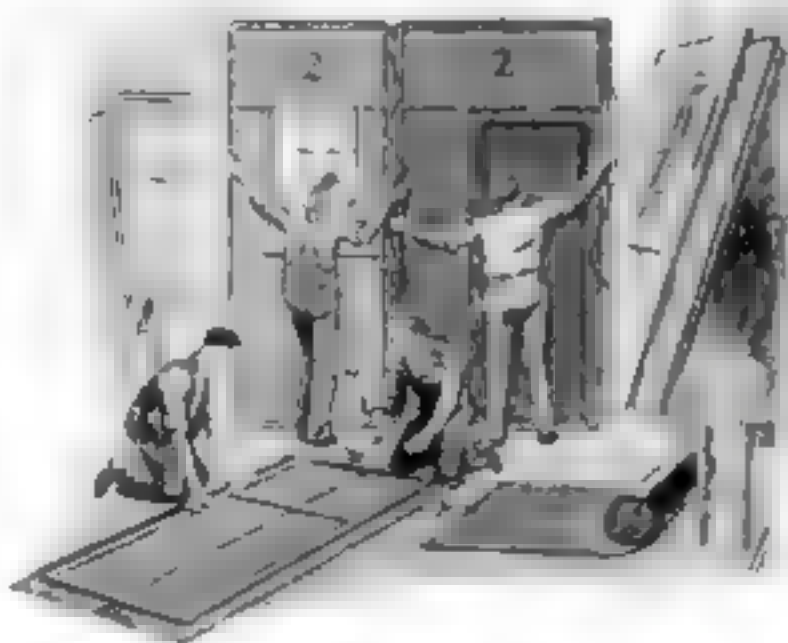
have their beginning or
development in the
mouth, throat and
nose. As the disease
progresses, it may
spread to other parts
of the body. Watch
your throat and
nose carefully. If
you notice any
sore, redness, or
difficulty in
swallowing, consult a physician.

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MANY a handy man will have to add the craft of scenewright to his accomplishments because of the growing interest everywhere in amateur theatricals. And it's lots of fun, in fact, one of the most fascinating side-lines for the home workshop enthusiast to take up.

SCENECRAFT—Building the Set

The Simplest Method of Making Frames—Third Article in a Series on Amateur Stage Carpentry

By ANDRE SMITH
Author of "The Scenewright"

IN DISCUSSING the making and covering of the actual frames for a stage setting, I must make it clear to the reader that I am addressing myself solely to beginners in the art of play producing and not to members of a thoroughly equipped little theater group who by means of a theater workshop and access to an ample purse are able to build their settings in a professional manner. I am writing for the lesser play-makers, whose purse, time and energy are limited, and who are putting on plays that are not intended for a run of a week or more, but for a one-night showing, or at the most two or three nights.

Play producing in this case is, I believe, not so much a matter of thoroughness as of proportion. And by that I mean a play put on by an experienced, permanent organization must be thoroughly well done. On the other hand, when a play is put on by an inexperienced group of amateurs for a one-night stand, paying, no doubt, a fat royalty in the face of a small house, the matter of economy is of utmost importance. But in saying this I do not in any way recommend careless presentation; far from it. I want merely to urge the amateur producer to see that his production is uniformly conceived and executed in proportion to the means at hand. Many a brave dramatic club has had to disband because of a disregard of this fact.

ACCORDINGLY, to these minor producers I urge the use of the simplest and cheapest materials. Furring strips for the frames and building paper for the covering of the frames.

And when I recommend the use of what may seem to the reader a mighty frail covering, let me say at once that I have used this method for years in the making of many amateur stage settings

and have found it serviceable. When properly applied, it has proved durable not only for the two or three nights of the performance, but also for rather rough motor transportation. In one outdoor play—fortunately after the audience had left—the paper-covered frames were given a rain test, but after an all-night soaking, they rallied in the sun-warmth of the following day, taut and sound as ever.

BUILDING paper for scene building is thoroughly serviceable and cheap, it is easily handled, and in the hands of an ingenious designer it can be shaped into truly amazing forms. I have seen this paper used to represent massive Egyptian columns, a huge stone fireplace, stone arches, heavy ceiling beams, a garden wall, brackets, and so forth. It stands to reason, however, that these frail imitations of solidity must be properly respected by the actors and the scene shifters. I once saw an overzealous comedian Charleston his foot through a wall that had every appearance of everlasting solidity. The audience, of course, enjoyed it, the scenewright did not, and what the director told the comedian still stands as a record in that particular club.

All that I have said about the economy and usefulness of building paper applies equally to the use of furring strips for making the frames. These two- or three-inch semirough wood strips will make frames sufficiently strong to withstand the comparatively short handling that they must endure. One must also keep in mind that the application of the stretched paper covering so stiffens them that for the average frame intended for an interior with an eight- or nine-foot ceiling, corner bracing is not necessary. And the lashing together of the entire set of frames serves, in turn, to stiffen the individual frames as well as (Continued on page 97)

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Micrometer Measuring Table

A Simple Holder for a Standard Caliper Head Which Makes It Easy to Measure Awkward Parts Accurately and Quickly

By HENRY SIMON

ONCE made, the micrometer measuring table illustrated is one of those devices for which new uses are found every day. It combines a remarkable degree of versatility with the utmost simplicity of construction. Because of the fact that it has no movable parts other than the spindle itself, the possible sources of error are reduced to a minimum, while the ends of accuracy and of rapid work are served by the provision of means for clamping various auxiliary equipment to the table in almost any position without resorting to undesirable makeshifts and cluttering up the working space.

The instrument consists of a standard 1-in. micrometer barrel (A) mounted in the overarm of a frame (B), which is held in position on a base (C) by means of four countersunk screws (D). The base is a $4\frac{1}{2}$ -in. square of $\frac{1}{2}$ -in. tool steel, beveled on the upper edges. In addition to the holes for the frame screws, it is provided with a number of $\frac{1}{8}$ -in. SAE tapped holes to serve for screws used in attaching any devices it may be desired to use.

The frame may be made from machine or tool steel, and its design, like that of the table, is intentionally heavy in order to reduce spring and to afford a good footing on the base. It may be made of ordinary machine steel, though the extra labor of making it from nonshrinking tool steel, heat treating it, and grinding the registering surfaces will be well spent. The frictional hold of the annular seat upon the barrel should be firm, but not excessive; it must not bind the spindle.

THE bottom of the frame is relieved over the center portions so as to cause only the four corners to bear. It will be noted that the design is such as to allow it to be formed largely by the use of a milling cutter, it may be held



Single pieces of unusual shape can be measured with precision or duplicate parts gauged rapidly

in an ordinary vise in almost any position even when finished. A small cross-drilled hole (E) passing through both sides of the annular part is provided to receive

a pin from either side for fixing the barrel in its final position, if desired.

In the table illustrated, the extreme height of the spindle is 1.250 in. This may be changed according to conditions, but should be kept to even fractions not smaller than $\frac{1}{8}$ in., as 1.000, 1.250, 1.500, or 2.000 in., so as to avoid confusion in reading measurements.

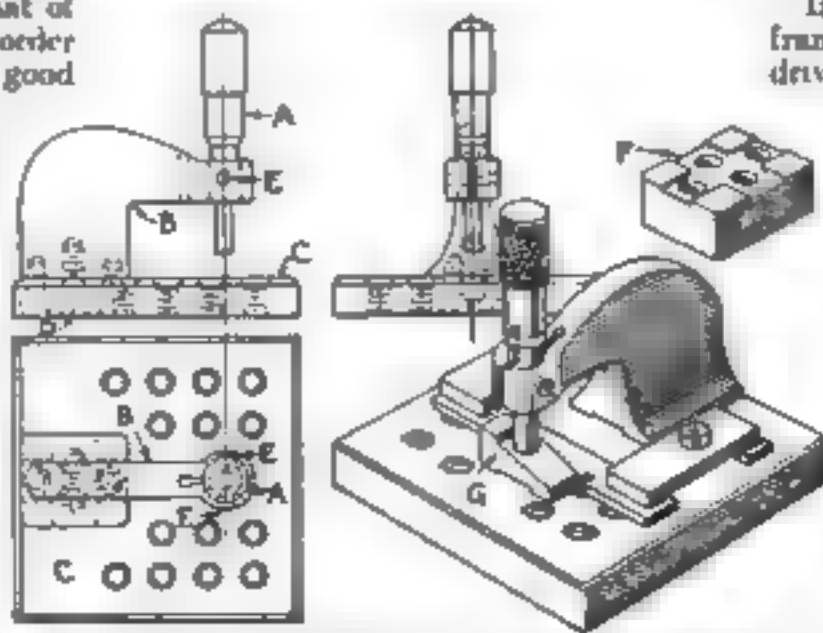
THE instrument may be adapted to a wider range of work by the use of raising blocks such as shown at F. The holes through them should be large enough to allow the frame screws to pass through without binding. The blocks also should be hardened.

The table, at all events, must be hardened and drawn at from 400 to 425 deg., or to a pale yellow, and ground and lapped. The tapped holes in the foot of the frame serve to hold it to the faceplate for turning or grinding, so that the fastening on the faceplate is exactly the same as that on the finished instrument. It is, therefore, easy to make the only two registering surfaces—the barrel hole and frame foot—true in relation to each other.

In assembling the instrument, after the frame is mounted on the base, a screw driver blade or some other wedge is used to spread the slot slightly, when the barrel, with the spindle set at 0, may be slid down on to the table or to a size block and there locked by withdrawing the wedge. After the instrument has been in use for some time, the barrel may also be pinned through hole E, if desired. A soft pin with a central hole through it should be used, to make it possible to drill it out.

(Continued on page 93.)

OTHER timesaving shop ideas are contained in the continuation of the Better Shop Methods Department, to be found on pages 84, 92 and 93.



How the measuring table is made. For larger work the overarm which holds the micrometer head may be raised by block F

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Quick-Change Grinding Set-Up

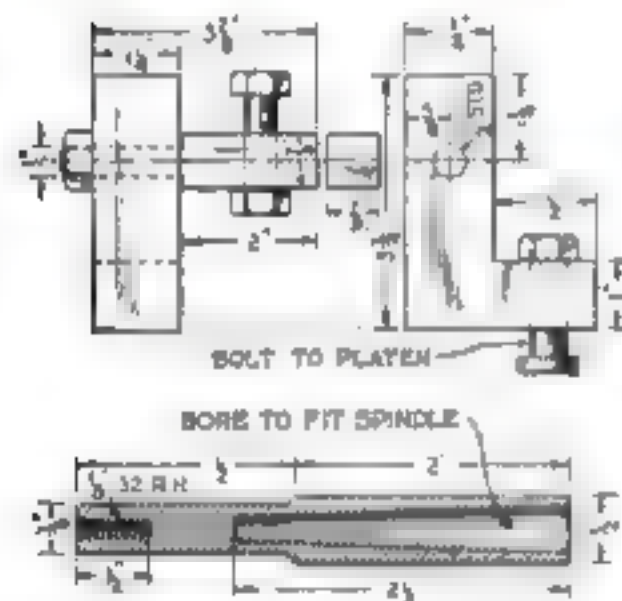
By HECTOR J. CHAMBERLAND

ANY machinist familiar with a tool-room grinding will note the advantages of the combination illustrated, which makes possible a quick change from cylindrical to internal grinding. The change may be accomplished in about three minutes.

In this particular case the small tool-post grinder is retained as per-



Tool-post grinder set up on a universal grinder for doing both cylindrical and internal grinding



Fixture for holding the tool post grinder and an extension for a high-speed spindle

manent equipment for the universal grinder and remains clamped to the machine most of the time. It is only necessary to throw off the wheel belt and swing the wheel plates around.

The fixture holding the tool-post grinder is made so that the wheel is radial with the work when it is correctly set. This is important in grinding any tapered hole. The piece being ground can be squared with the hole by removing the high-speed spindle and using the motor spindle as shown. Hubs and recesses can be ground the same way.

By reversing the grinder in the dovetail and using the motor spindle, holes 3 in. in diameter and 2 1/4 in. long can be ground with good results. An extension can be made to take work 1 in. longer than the regular spindle.

Overize Wheels Reduce Cost of Cylindrical Grinding

ON CYLINDRICAL grinding machines, whether of the plain or universal type, where the diameter of the wheel is 10 in., it is advisable to buy wheels 10 1/4 in. instead. The extra cost, if any will be small compared with the additional service the wheel will give. This is especially true if the general run of work is around 3/4 in. or smaller, as is so often the case.

How to Work with Copper Tubing

By KARL NIXON

BECAUSE of its extensive use for fuel and lubricating lines in automobiles, airplanes and various shop installations, an ever increasing number of mechanics have to know how to work with copper tubing—how to anneal, straighten, cut, bend, and install it.

In specifying copper tubing the outside diameter is given in sixteenths of an inch, together with the wall thickness. It is available in all sizes from 3/4 in. O. D. up, and in many thicknesses.

It is customary to specify the outside diameter by a number indicating the size in sixteenths of an inch. Thus, No. 8 copper tube is 3/4 in. O. D. and No. 4 is 1 1/4 in. O. D. The wall thickness is specified in thousandths of an inch. Combining these, 8030 means 3/4 in. O. D. and .030 in. wall and 12030 is 1 1/4 in. O. D. and .030 in. wall.

Copper tube is sold either in coils or straight lengths, the smaller sizes usually in coils. Various tempers are available—full hard, half hard, quarter hard or dead soft. It is customary to anneal tubing before bending and installing.

THE annealing is a simple process. The tube is merely heated to a fairly bright red heat in any suitable furnace and quenched immediately in water, or it may be allowed to cool in the air with satisfactory results. When a tube is quickly quenched after heating, any scales which have been formed will be thrown off and the tube left fairly bright and clean. Care should be taken not to overheat copper, and, after annealing, tubing should be handled with care, as it is comparatively soft and easily distorted. After distortion, it is diffi- (Continued on page 92)

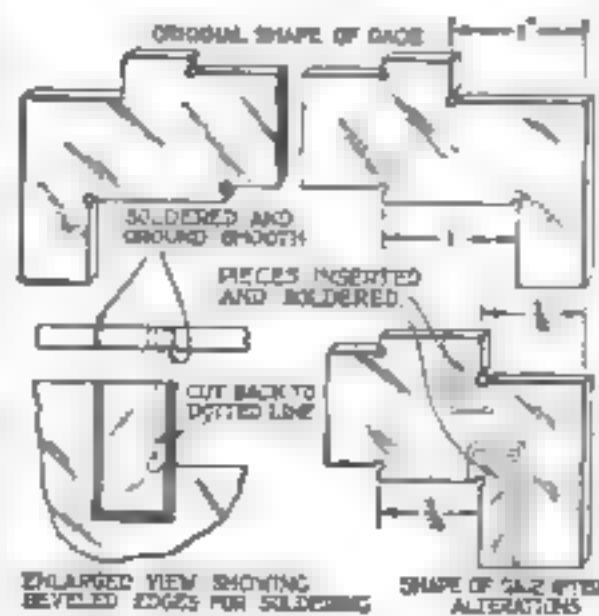
Skilful Patching Saves Two Costly Gages

TWO snap gages had been made and were ready for grinding in one large shop when changes made by the engineering department in the design of the work resulted in their becoming worthless.

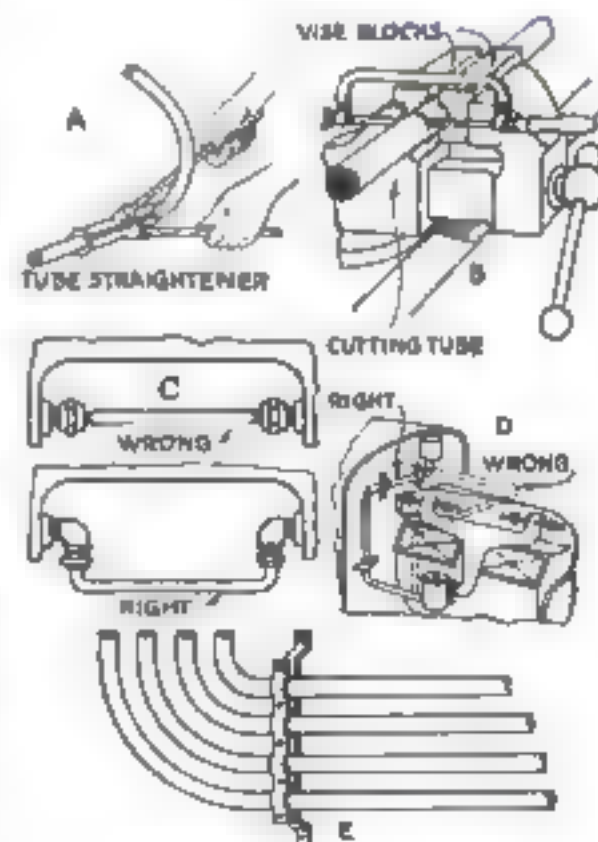
The writer was told to make two new gages to correspond with the revised design, but suggested that the original gages might be saved by following the method illustrated. The results were satisfactory and the saving amounted to eleven dollars.

After grinding off sections 1/4 in. wide in the proper locations, pieces of tool steel were made, hardened, ground and fitted snugly in place as shown. Beveling the edges made it easier to solder these pieces.

After the gages had been surfaced off on the sides and ground all over, there were hardly any indications of how the repair had been made. H. C.



The original design for the gages, which had to be changed in respect to two of their dimensions, how the alterations were made



Using straightener cutting tube, typical installations to show the correct methods

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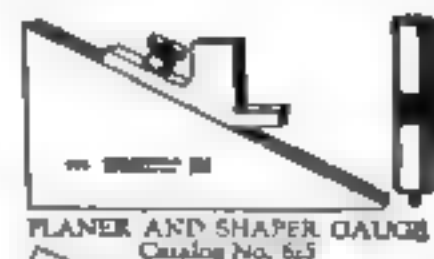
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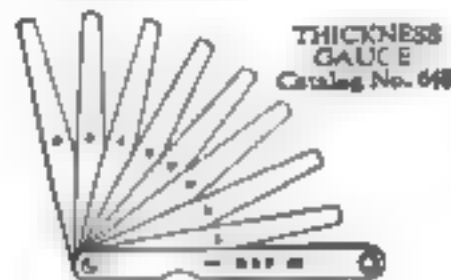
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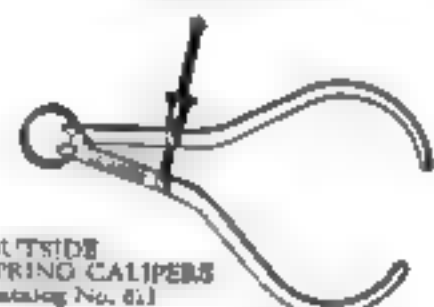
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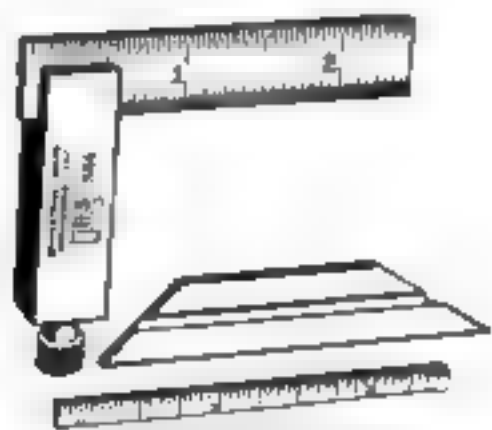
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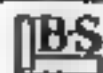
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THE SHIPSHAPE HOME

Hints on Handling and Cutting Glass

By EMANUEL E. ERICSON



Fig. 1 (upper view). How to make measure-
ments. Fig. 2 (lower view). Lifting glass

*In keeping a home shipshape it is often neces-
sary to replace broken window glass or repair the
putty where it has cracked and come loose from
the panes. Just what you need to know about
this work is told in this article and one to follow,
both by Mr. Ericson, who is the author of "Glass
and Glazing," one of the standard books on the
subject.*

MANY a person who has observed
an experienced glazier handle
window glass with ease and ra-
pidity has felt encouraged to do some
glass cutting for himself but usually with
a disappointing outcome. Others have
never had the courage to try to use a
glass cutter; to them the process of cut-
ting glass is a mystery.

In reality there is nothing difficult
about handling and cutting window glass
of small dimensions provided a few simple
rules are followed.

In the first place, it must be remem-
bered that glass is a brittle substance.
More glass is probably broken by ama-
teurs in picking up and moving it about
than in the actual process of cutting it.

Glass will not stand being picked up
by one hand like a china plate. It will
not support its own weight when so
handled. The safest way to lift glass is
by holding it in a hanging position as
shown in Fig. 2. Use both hands and
allow the glass to hang free. Then place
it on edge on the table and lay it down
carefully, supporting it with both hands,
the fingers widely spread.

When the glass is safely on the table,
half the battle is won. Now it can be
moved about as needed for the cutting.
Figure 1 shows how to take measure-
ments on a piece of glass. A mark is
made at each edge of the piece with due
allowance for the distance between the
wheel of the cutter and the end of the

rule. A yardstick is a satisfactory mea-
suring stick and straightedge for smaller
jobs, as shown in Fig. 3.

For cutting, the glass should be placed
on the table with the hollow or concave
side up; there will be less strain while the
cutter passes over it.

The best way to hold the glass cutter
is indicated in Fig. 3. In cutting window
glass it should be remembered that the
lightest pressure that will make the cutter
"cut" is the proper pressure to use.
Invariably beginners make the error of
pressing too hard upon the cutter and
producing a great scratch instead of a
smooth, fine cut.

IT IS not wise to attempt to use a worn-
out cutter, for glass cutters are cheaper
than window glass. Neither is it advis-
able for the amateur to aspire to own a
diamond for glass cutting, in unskilled
hands it will probably do poorer work
than a wheel cutter. Sometimes when a
wheel cutter refuses to cut under ordinary
pressure a dip in kerosene will restore its
cutting quality.

When the cut has been successfully
made, the glass must be split on the cut-
ting line. This may be done either by
breaking it apart with the hands or by
tapping with the cutter as shown in
Fig. 4 until it comes apart. On larger
pieces the latter method is advisable
because it is safer. The notches in the
cutter are used for removing strips that
are too small to be taken off otherwise.
In breaking the glass apart, always bend
it downward, so that the opening or
breaks will be made from the side upon
which the cut was made.

On smaller pieces or on repair work,
the glass is simply cut over the frame
as shown in Fig. 5. In this case the
cutter is made to follow inside of the
edge where the glass is to fit. When using
this method, place the glass with the
hollow side down instead of up in order
to withstand the strain at the corners.
On small pieces, however, this is not
highly important.

Glazier's points are triangular pieces
of soft metal. (Continued on page 88.)



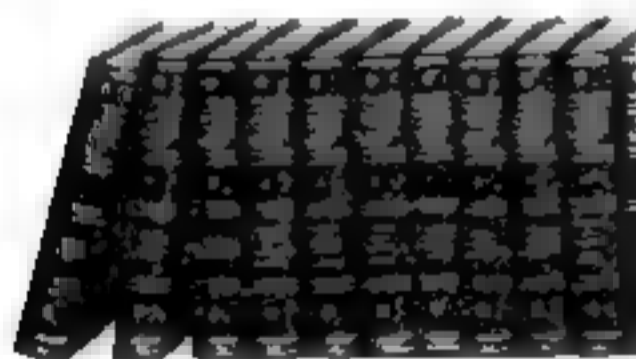
Fig. 3. The glass cutter is best held as
shown and pressed firmly but not too hard

"IF TIME is precious," said Carlyle, "no book that will not improve by repeated readings deserves to be read at all." Time nowadays is more precious than ever before. Yet nobody questions the fact that good reading is an essential part of every human life.

But how can the busy man or woman take the time to cull the best out of the hopelessly large amount of literature that has been written, when a modern public library contains hundreds of thousands of books?

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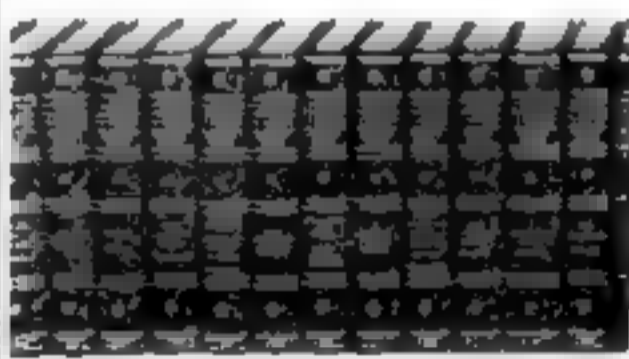


EMERSON once said. "Would that — charitable soul, after losing a great deal of time among the false books, and alighting upon the few true ones which made him happy and wise, would name those which have been bridges or ships to carry him over the dark morasses and barren oceans, into sacred cities, into palaces and temples."

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The publishers cannot undertake to send the booklet free to children.

Fisherman Says He Never Gets a "Bite" From This Tobacco

The sport of fishing seems to enlarge men's souls, despite all the fish stories we hear. Let a man find a hole where the fish are biting well, and nine times out of ten, if he is a true sportsman, he will let his friends in on the good news.

Evidently the same thing holds true of pipe-smokers. Take the case of Mr. Blawey, for example. He has learned from a fellow fisherman how good Edgeworth is, and now wants to tell the world about it himself.

Jasper, Tenn.,
March 23, 1927

Larus & Ben Co.,
Richmond, Va.
Gentlemen:

I have always wanted to smoke a pipe. After several attempts I gave my taste up, for with each trial I got a blistered tongue.

One evening, when looking over a certain outdoor magazine, I read that a certain fisherman could catch more fish when using Edgeworth, so I decided I would try "his" tobacco—for I am no pure fisherman!

The next day I tried to secure Edgeworth. The local country storekeeper did not have it, so I sent by a friend to the city for my first Edgeworth. Two things have happened. I am smoke Edgeworth, and the local storekeeper always has a supply. I catch fish and never get a bite from Edgeworth!

Yours for keeps,
H. V. Blawey

To those who have never tried Edgeworth, we make this offer:

Let us send you free samples of Edgeworth so that you may put it to the pipe test. If you like the samples, you'll like Edgeworth wherever and whenever you buy it, for it never changes in quality.

Write your name and address to

Larus & Brother Company, 10 E. 21st Street, Richmond, Va.

We'll be grateful for the name and address of your tobacco dealer, too, if you care to add them.

Edgeworth is sold in various sizes to suit the needs and means of all purchasers. Both Edgeworth Plug Slice and Edgeworth Ready-Rubbed are packed in small, pocket-size packages, in handsome humidor holding a pound, and also in several handy in-between sizes.

[On your radio—tune in on WRVA, Richmond, Va.—the Edgeworth Station. Wave length 1234.1 meters 1180 kilocycles.]

THE SHIPSHAPE HOME

(Continued from page 85)



Fig. 4 (in circle). Tapping underneath a cut to cause separation. Fig. 5. In small work the glass may be cut over the frame.

used as shown in Fig. 6 to hold the glass in place. They are hammered in with a square-edge chisel which is made to slide back and forth on the glass as the blow is struck. The points must be so laid that the "burr" on the sharp corners points upward. If pointing downward it is likely to draw the point down at an angle and perhaps break the glass.

If considerable cutting is done, it is well to have a special table or board for the purpose crosslined in 1-in. squares. For a small amount of work a paper so laid off will serve the same purpose.

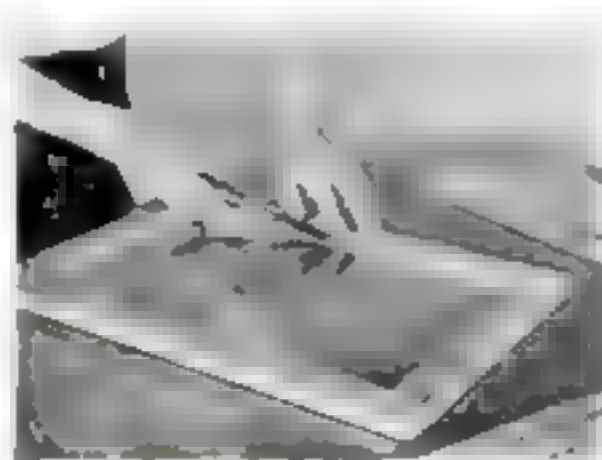


Fig. 6. Window glass is held in place with glazier's points, driven partly into the wood.

Ventilating Screens

In severe winter when it is too bitterly cold and windy to allow the windows to be left open, adequate ventilation may be insured by making narrow wooden frames covered with cotton for use as ventilators. It is often sufficient if the frames are 1 in. wide, inside measure-

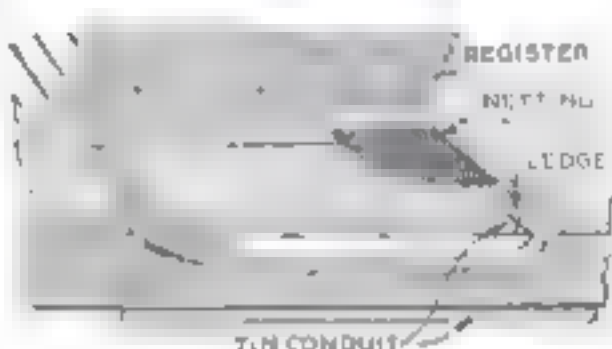
ment, and they rarely need to be more than 4 in. Their length depends upon the width of the sash. When the lower sash is raised, one cotton screen is inserted beneath it, and similarly, when the upper sash is lowered, another frame is placed above it. Pads are made to fit snugly between the glass of the upper sash and the meeting rail of the lower sash to prevent a draft there.

The cold fresh air filters in through the lower screen and the warm used air flows out at the top. It is necessary to have both screens to insure perfect ventilation.

—P. H. ARMBY.

Screening Registers

KEYS, coins and other small articles cannot fall through a cold or hot air register in the floor if a piece of mosquito netting (wire cloth) is fitted underneath the iron grid as illustrated. It is necessary only to unscrew the grate.



Wire cloth such as is used for window screens is placed beneath the floor register grillwork.

cut the netting the correct size, set it in place, and refasten the ironwork.

I used this method recently in the home of a friend who had been seriously inconvenienced when his little girl dropped the key to his automobile down a register. —ERIC B. ROBERTS.

Thawing Water Pipes

Not least among the trials of winter is the freezing of a water pipe. A plumber is not always available and you may find yourself up against a real emergency, especially if the cold water pipe has become frozen in a section that is out of reach in the walls. This was the case recently in the writer's experience.

First, get up a good supply of hot water in the boiler. Then go to your bathtub or sink where there is a combined cold and hot water faucet and, after the water is running hot, turn it off and plug the faucet with a cork or some other stopper. Again turn on the hot water, which will be diverted into the cold water pipe and forced in the direction of the frozen section.

A first attempt may be unsuccessful. If so, open any other taps you may have about and try two or three more applications of hot water, as hot as you can get it. Allow a few minutes interval each time for thawing. In many cases this will accomplish the desired result quickly and without expense. —K. GIBSON.

Toy Boat for Ice, Land and Water

By E. J. QUINN

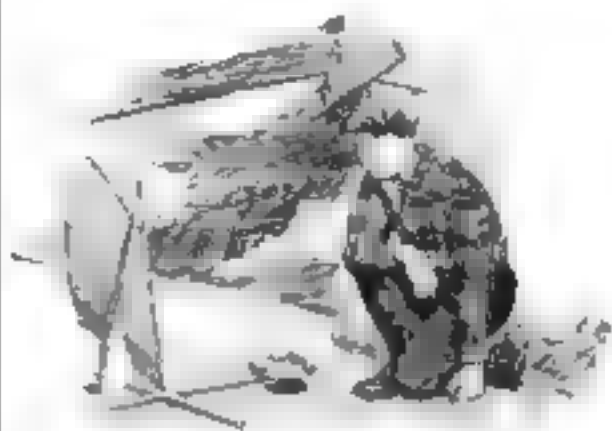


Fig. 1. Used as a miniature ice boat, this toy furnishes fine winter sport for boys.

THE convertible ice, land and water sailboat illustrated is an all-year-round toy. It can be built in any convenient size. One feature is that when the boat is used on the water, it is not apt to turn over, as many toy yachts do.

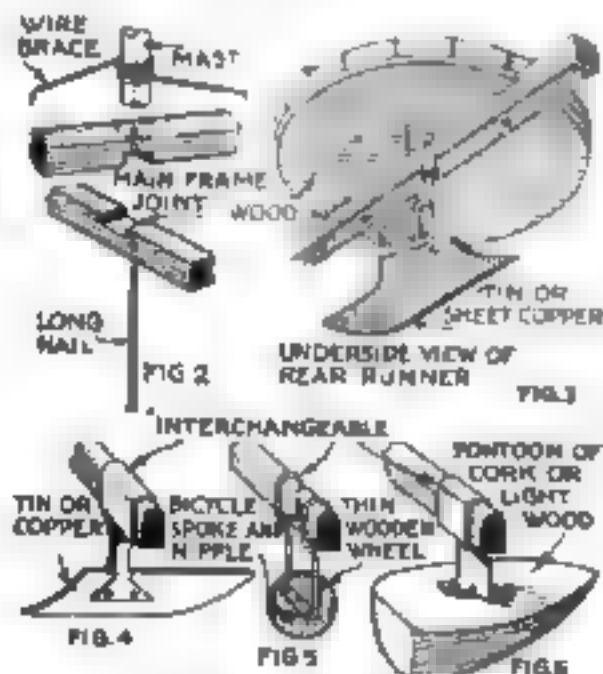
When equipped with runners for sailing on ice or hard crusted snow, the boat appears as in Fig. 1. The method of connecting mast and main frame is shown in Fig. 2.

The rear runner, Fig. 3, may be turned to vary the direction of sailing. The sheet metal attachment is bent to form a tapered socket that can be slipped on and off the wire steering arm. While no separate detail is given of the rear construction when wheels or pontoons are used, it is obvious that the same method will serve.

For the forward runners, Fig. 4, the brackets should be shaped around the tapering cross-frame so they also can be slipped off or on. The runners are either soldered or riveted to their supports.

Frames for the wheels are bent out of bicycle spoke wire as indicated in Fig. 5. The wheels are cut from cigar-box or other thin wood. The hub for each wheel is half of a bicycle-spoke nipple.

The pontoons, Fig. 6, should be made of cork, but if this is not available, some light wood can be used.



Figs. 2 to 6. How the interchangeable runners, wheels and pontoons are made, and a detail of the main frame and mast step.

You can't loosen a "YANKEE" Handle

This man drove the blade of Yankee No. 90 Plain Screw-driver right through a four-inch plank without splitting the handle.



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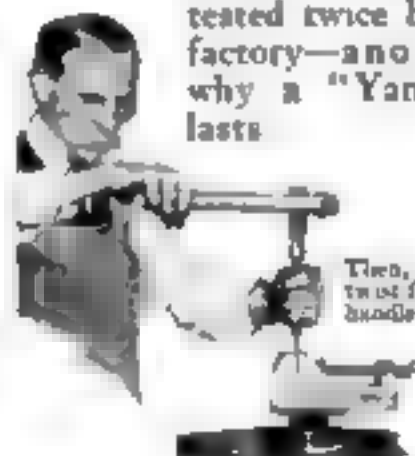
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Every individual blade is tested twice before leaving factory—another reason why a "Yankee" Driver lasts.



He used a heavy mallet on No. 90 but that didn't matter.



Then, this powerful twist failed to turn handle up the blade.

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The
Cheney Nailer

A Gift Puzzle for Children

You Can Make It in an Hour or Two from Cigar Boxes—Fascinating but Not Hard to Solve

By ARTHUR L. SMITH

IN FIGS. 1 and 2 below is shown a block puzzle designed to interest the little

folks and made entirely of cigar box stuff. It is a little better if the box has a sliding cover constructed with square corners as described on page 78 of the last JUNE issue of POPULAR SCIENCE MONTHLY or, as illustrated in Fig. 3, with mitered corners, which make a neater finish for those who take the trouble to fit them well.

The narrow strips in Figs. 1 and 2 are all $\frac{1}{4}$ in. wide. The twelve blocks are 1 in. square and lettered WAS THE BOY

JIM. The puzzle may be made of other dimensions if the proper proportions are observed. The blocks must be square; the inside width of the box must be equal to four blocks and the inside length equal to five and one half blocks. The strips must be one half the width of a block and three blocks in length. This allows the letters WAS, for instance, to be moved out along the side so that the three blocks will not reach higher than the bottom of the letters THE. The blocks THE may then be moved into the space formerly occupied by WAS. The puzzle consists in moving the blocks in this way so as to change the position from Fig. 1 to Fig. 2.

Puzzles of this character could be made of more and longer words. Three-letter words were chosen to make it easy for children and of such character that no letter is repeated. It is well to print the sentences, WAS THE BOY JIM

and JIM WAS THE BOY, on the cover of the puzzle to aid the memory.

Those who are skillful in the formerly popular art of pyrography can burn the letters on the blocks and on the cover before finishing. Rosewood stain or red cigar box wood makes a beautiful finish.

To illustrate the solution, the squares are numbered in Fig. 3 from 1 to 17. Number 9 is $1\frac{1}{4}$ in. long. This will allow block 12 to be removed when three blocks occupy positions 9, 15, 17.

In the solution below only the letter and the number of the space to which it is moved is given, for example, M17 indicates that block M is to be moved to the seventeenth square.

To change WAS THE BOY JIM to JIM WAS THE BOY—S17 A15 W9 E1 H2 T3 W4 A7 S8 Y4 O3 B10 I11 J12 B14 O13 Y16 J4 I17 S11 A12 I7 J8 T17 H13 E9 J1 I2 E3 H4 A7 S8 M3 T10 M17 H11 E12 M9.

The reverse solution is—S17 A15 W9 M6 I7 J8 W1 A2 S3 Y4 O3 B9 E14 H13 T16 B10 O11 Y12 J4 I17 Y7 O8 I11 J12 T4 H3 E9 J14 I15 E10 H17 O11 Y12 M13 T6 M4 H7 E8 M16.

While these are the fewest moves in which the author has solved the puzzle, possibly someone may find a still shorter method.

In Figs. 1, 2 and 3, below, a plain case is shown without the cover.

Before giving the puzzle to Johnny, see how many moves you take to solve it yourself.

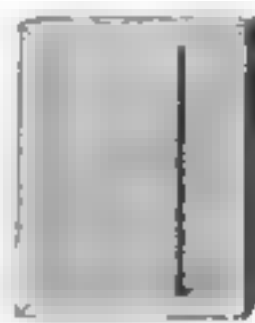


FIG. 1

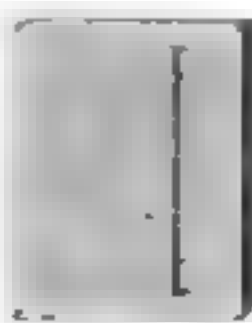


FIG. 2



FIG. 3

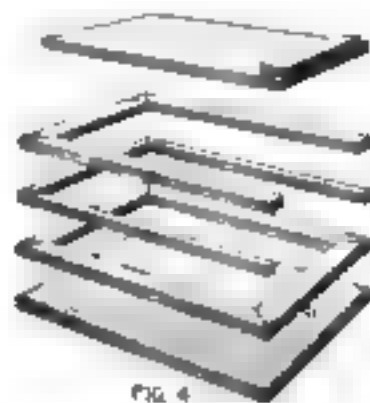


FIG. 4

The first and second positions, the key to the solution, and the case

Hinges for box covers can be made of wire when it is not worth while to buy and apply regular hinges. Drill a hole at an angle of about 45 degs. down through the side of the box and pass both ends of a

short piece of wire through it. Separate the ends and bend each over so they can be driven into the wood. Pass the other member of the hinge through a hole drilled in the cover and fasten by clinching



Home Workshop Chemistry

*Simple Formulas that
Will Save Time
and Money*

PAPER funnels for the chemist, photographer or other user of liquids can be made from heavy envelopes such as those in which photographic papers come.

The funnel is formed by cutting off a corner of the envelope. The cut takes the path of a quarter circle at a distance of



Funnels may be cut from heavy envelopes such as those used for photographic papers.

3 or 4 in. from the corner. The tip of the cone thus formed is then clipped off as shown.

After being used once, the funnel is discarded. This prevents the chance mixing of liquids, which may result from using one funnel repeatedly without washing it properly.—WALTER E. BURTON

THE term "hot acid bath" will be met with occasionally in this column and in books and various pamphlets of formulas. It means a solution of acid that has been heated very carefully in a pan of water on the double boiler principle. Place the cold acid in a glass beaker or other container and set the dish in a pan of water. Heat very slowly over a small flame. It is advisable to place a bent piece of wire under the acid vessel so that the container will not come in contact with the bottom of the pan.

WHEN THE stopper of a cut glass bottle becomes so tightly stuck that it cannot be removed, it can be loosened, according to the recent announcement of a German experimenter, by placing on the joint a mixture of 5 parts glycerin, 10 parts chloral hydrate, 3 parts 25 percent HCl, and 5 parts water.

WITH FIVE packages of household dyes—brown, red, yellow, green and black—it is a simple matter to mix wood stains of almost any color or shade. Use the dyes sold for coloring silk and wool, not cotton. Sponge the wood, let it dry and sandpaper it lightly before applying the stain.

"Small-bubble" lather soaks every whisker

*Holds water like a sponge.
Softens each hair right where
it grows out*

AT the base, just where the razor edge works—that's where Colgate lather battles whiskers. Sopping-wet with water are its minute bubbles. They snuggle round each tiny hair, as the pictures below show.

How "small-bubble" lather works

The moment Colgate lather forms on your beard, two things happen:

1. The soap in the lather breaks up and floats away the oil film that covers each hair.
2. With the oil film gone, millions of tiny, water-saturated bubbles bring and hold an abundance of water down to the base of the beard, right where the razor does its work.



ORDINARY LATHER

This lather picture (greatly magnified) of ordinary shaving cream shows how large, air-filled bubbles fail to get down to the base of the beard and how they hold air instead of water, against whiskers.



COLGATE LATHER

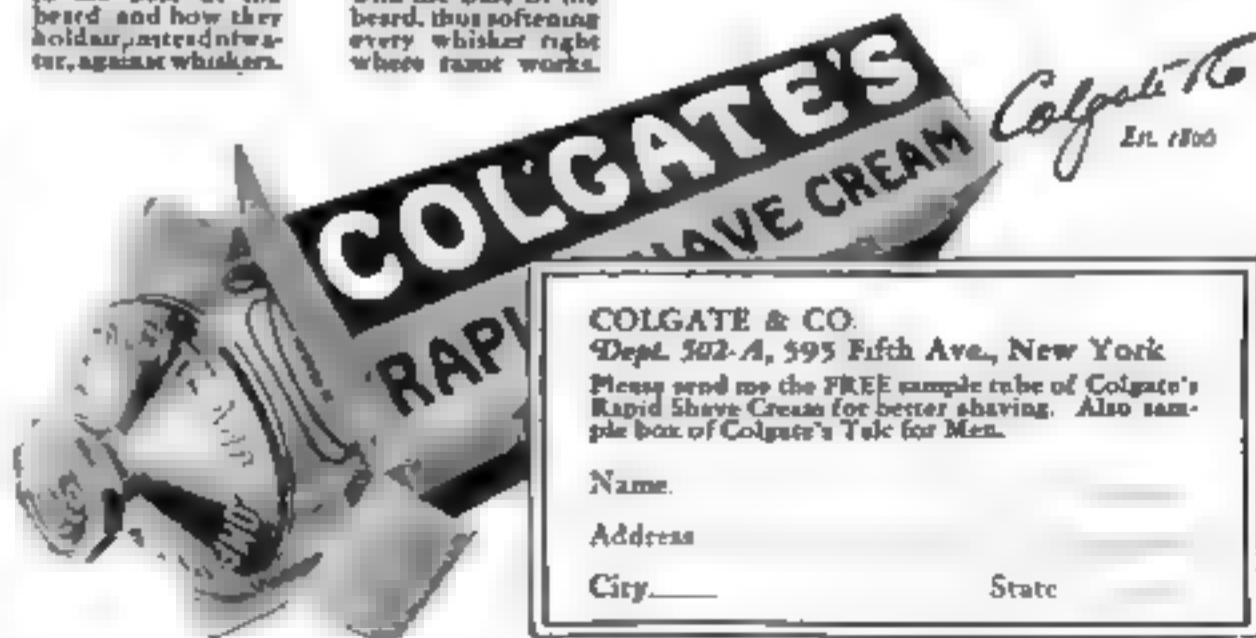
This picture of Colgate lather shows how myriads of tiny, moisture-laden bubbles hold water, not air, in direct contact with the base of the beard, thus softening every whisker right where razor works.



Because your beard is properly softened at its base, your razor works easily and quickly. Every hair is cut close and clean. And your face remains cool and comfortable through the day.

A WEEK'S SHAVES—FREE. Try this unique "small-bubble" lather at our expense. The coupon below will bring a generous trial-size tube—free.

EXTRA DIVIDEND! We will also include a sample box of Colgate's Talc for Men—the new after-shave powder that keeps your face looking freshly shaved all day long.



COLGATE & CO.

Dept. 302-A, 595 Fifth Ave., New York

Please send me the FREE sample tube of Colgate's Rapid Shave Cream for better shaving. Also sample box of Colgate's Talc for Men.

Name _____

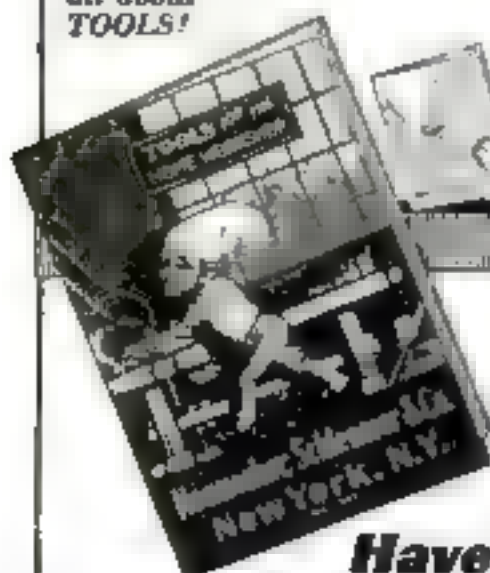
Address _____

City _____

State _____

SOFTENS THE BEARD AT THE BASE

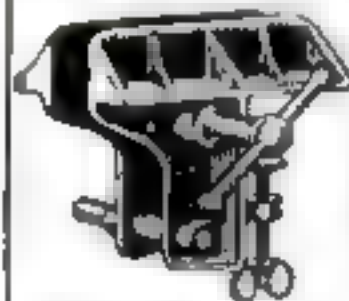
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PS 1

How to Work with Copper Tubing

(Continued from page 84)

cult to restore the true round contour.

The tube need not necessarily be annealed for its entire length, but may be heated just at the point where the bend is to be made and for a distance covering the bend. For this a common gasoline torch is satisfactory. After annealing, there is but one way to restore temper to copper tube; that is by redrawing or working the tube. However, since the tube has a tendency to harden and regain its temper in service, it is customary to reanneal it periodically in installations subjected to severe vibrational strains. Tubes may be reannealed repeatedly without the metal's deteriorating.

COILED tube, usually purchased dead soft, is best straightened by using a suitable straightener, such as illustrated at A. Tube straighteners have means for fastening them to a bench, so that the coil may be controlled with one hand.

When cutting tube, use a fine-tooth hack-saw blade. Grip the tube in a vise provided with tube vise blocks of the correct half-round size, as shown at B. Never grip a tube in a pipe vise with sharp teeth. If facilities do not permit the use of tube vise blocks, be sure that the vise jaws are smooth or use soft metal pads to cover them, and grip the tube lightly over a considerable length, being careful not to flatten the tube by too great pressure. Coarse-tooth hack-saw blades have a tendency to snag.

Tubes of the smaller sizes, when fully annealed, may be readily bent by hand. The bends should be made gradually and worked into shape with continual caution to see that the tube does not collapse.

If a difficult short bend has to be made, the tube may be filled with sand and the ends may be plugged. Use either a plug connection or squeeze the ends of the tube together in a vise after filling. Short bends may be made in this way. Tubes may be filled with a liquid, provided the ends are securely closed and the tube is comparatively free from air pockets.

ONE of the great advantages of copper tube is the facility with which it may be bent. In making tube installations, it is well to take full advantage of this characteristic and bend the tube to conform to the contour of the machine or unit upon which it is to be installed.

Never install a tube directly between two fittings in a straight line as at C. Such an installation is difficult to make and is almost certain to give trouble. As a rule, it is highly desirable that all tube installations on a motor or gas engine be made so that the tube follows the contour of the motor.

Never run tubing directly from the upper part of the motor to the cowl or body of the vehicle. The point of least vibrational strain in a motor is at the mounting itself; the more remote the tube outlet is from the mounting brackets, the more the vibrational strains are accentuated and increased. This is also

true of tanks and other large units mounted in a vehicle. If the tube unit must be run from a part of such units remote from the mounting brackets, it is well to have the tube follow the contour of the unit to the mounting bracket and thence along the supporting member to the outlet.

Do not carry a direct tube connection from the cowl, dash, vacuum tank or other units mounted on the cowl or dash of a vehicle to the top of the motor. Bring the tube down the cowl or dash to the side of the supporting member and thence along the member to the mounting brackets of the motor or unit to the outlet, as at D.

It is good practice to install a tube union or other fitting on the line close to the motor mounting, so that the line may be broken at that point for repairs or new installations. In fact, it is best to use tube unions freely in all lines, placing them so that they are readily accessible. New tube lengths then may be installed without replacing the whole line.

Where a number of tubes are to be installed in parallel lines, it is advisable to group them where possible, but the method of grouping them without separation of the tubes and taping them together promiscuously is not recommended. It is advisable to arrange the tubes uniformly as at E and clip each tube separately.

Timesaving Jig Aids in Drilling Round Stock

A JIG like that below will prove a timesaver in drilling round stock.

A small V is milled at the bottom, and central with it a $\frac{1}{2}$ -in. hole is bored to take bushings for drills ranging from $\frac{1}{16}$ to $\frac{1}{2}$ in. inclusive. One end of the jig has an adjustment with a lock nut to



The jig, 1 by 1 1/2 by 3 in., and the bushings
are of machinery steel and case-hardened.

regulate the distance of the hole from the end of the piece to be drilled; this stop can be turned upwards out of the way if desired.

The bushings, like the jig, are made of machinery steel, turned and reamed to size and pack-hardened. The holes are then lapped to fit their respective drills. The bushings are held in place by a set screw.—H. J. C.

Portable Steam Boiler for Thawing Pipes

THE sheet metal boiler illustrated below is used during the winter by a plumbing concern in Golden, Colorado, for thawing out frozen pipes.

It consists of a boiler 18 by 10 in., of eighteen-gage steel, carefully riveted at all seams, and an enclosing hood of similar material, which is supported on legs of



Steam is generated in this shop-made boiler by means of a plumber's gasoline torch.

1-in. angle iron. The safety valve was made from the float of a toilet by cutting away part of one side of the valve, so as to let the steam out when the pressure lifts a small leaden weight on the valve lever. Steam is quickly raised by lighting a gasoline torch beneath the hood.

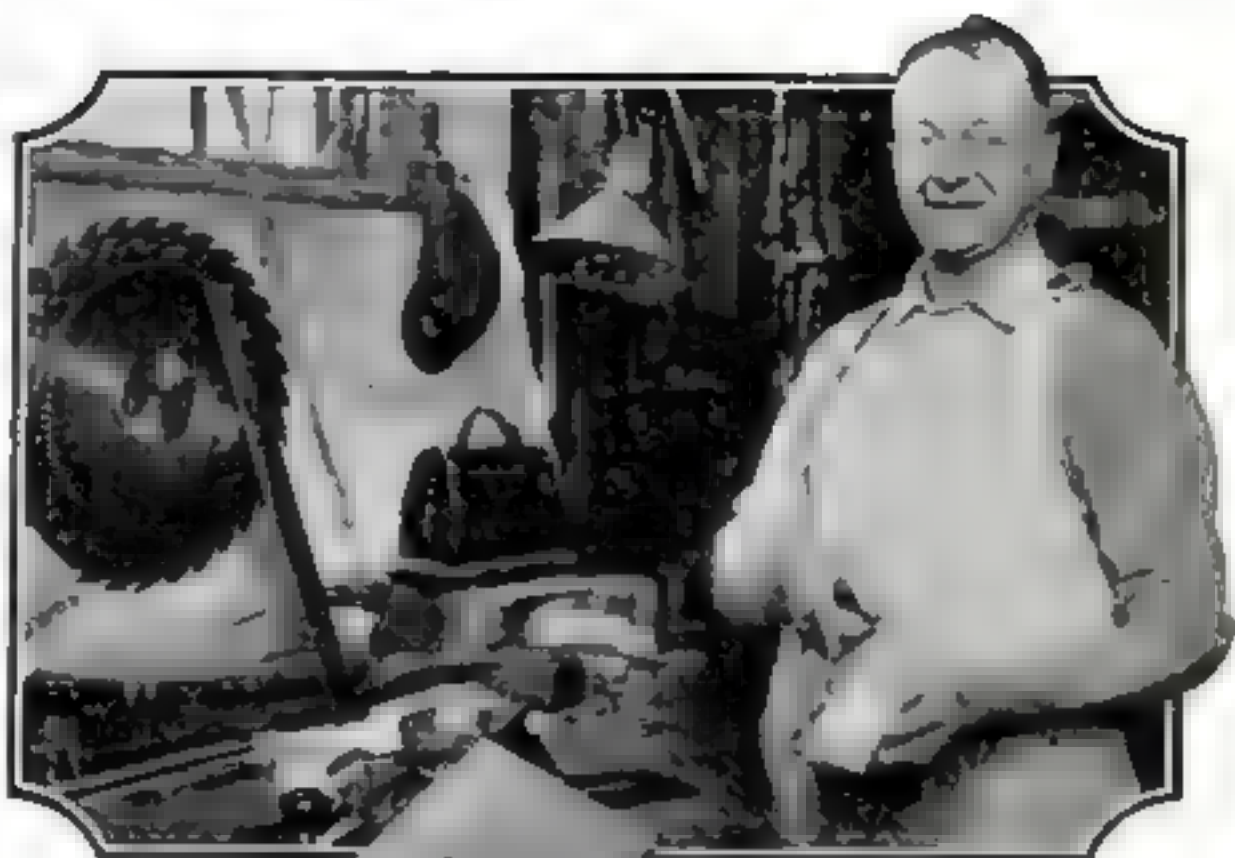
A 10-in. length of $\frac{3}{4}$ -in. pipe allows a steam hose to be connected to the boiler. The end of the hose is placed in an opening in the frozen pipe. The device is easily hauled about.—JOSEPH C. COVIL.

LOST MOTION sometimes can be taken up in a machine without disassembling it by making a washer of wire and slipping the ends over the rod, bolt, or other part. The washer then can be closed by holding a bar of iron on one side and striking the opposite side.—FRANK W. WILDER.

Micrometer Measuring Table

(Continued from page 84)

Only one out of hundreds of uses for the instrument is illustrated. This was not chosen because it is a particularly good example, as there are many more practical and obvious uses for the table, but it will serve to illustrate what can be done in an unusual case, especially in a shop where facilities for inspecting work are limited. The problem is to establish the taper and thickness of a part (G) by comparing it with a gage formed by clamping a notched piece of flat stock to the base, the width of the notch representing the permissible tolerance. Such a part would be extremely difficult to measure with either a micrometer or a vernier caliper, while a dial test gage, though able to compare the taper, would not give the actual height dimensions with any degree of satisfaction. The present instrument measures with equal facility the various dimensions of a single such part, or serves as a ready and convenient gage for duplicate pieces.



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The True Santa Maria

(Continued from page 78)

stanchions and skids. There should be four stanchions to a side and to right aft, although these may be omitted. From the half deck to the stern there are four to a side, nailed to the inside of the bulwarks. They slope slightly aft. To the sides of these, level with their tops, are nailed skids, the forward one being $3\frac{1}{2}$ in. long and the after one $2\frac{1}{2}$ in. The others are lined up between lengths. The two after stanchions are similarly shaped, they support the after skid from underneath.

On these rests the after castle, which is similar to the fore-castle. The deck is cut to fit on the skids, but is just $\frac{1}{4}$ in. less in width. Instead of a center opening at the after end, there is one at each side to lead into the half deck.

On this are erected the stanchions and skids for the tilt or awning. This has center posts $1\frac{1}{2}$ in. long aft and $1\frac{1}{4}$ in. long forward, the forward one being $\frac{1}{2}$ in. off center to make room for the mainmast. On these rests a four-and-a-half skid, and from it to the side posts, which are $1\frac{1}{2}$ in. long, are stretchers with light skids supporting their outer ends where they meet the uprights.

All these parts are stained light and dark brown with blue outside to match the forward part.

A little awning from some gay striped material of rough texture may be made to cover this. It had better not be spread right over, however, but should be rolled up and bound to one of the athwart skids.

This top part should not be put in position until after the mainmast has been rigged.

Note that, to save space, I frequently say nail or glue, but in every case, throughout the model, parts should be both nailed and glued wherever possible. For very small nailing, $\frac{1}{8}$ in. long tank pins are best, but where possible $\frac{1}{4}$ in. or longer No. 20 heads should be used.

On the main deck there will be a hatch, which can be made of wood $\frac{1}{2}$ by 1 by $1\frac{1}{2}$ in. with a line scored around the top to represent the part that lifts off. It should be stained almost black and glued to the deck 3 in. forward



The strips for supporting the fore-castle and the framework for the stern superstructure.

of line IV. Another hatch, somewhat smaller, will be between the main and mainmast.

There should be a ladder with four steps at one side of the mainmast, leading from the lower main to the poop. It is made from flat strips of wood about $\frac{1}{8}$ in. wide and as thin as you can handle them.

The following parts can now be made, but should not be put in position until after the rigging is done.

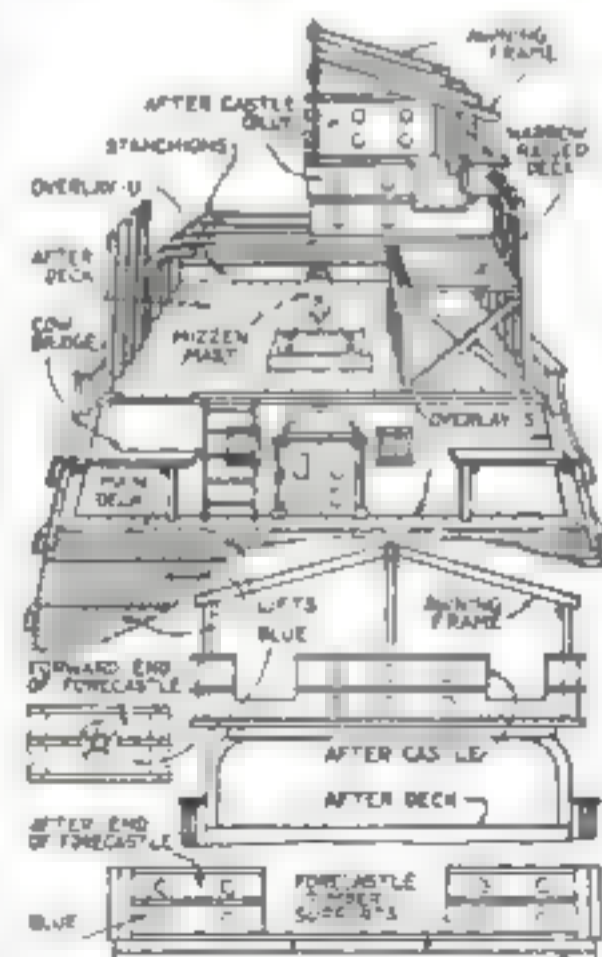
Two light cannon on swivel supports. There is no certainty as to the exact pattern of these, but I believe they would be much as shown on Blueprint No. 75. These are made from wood, but if you are a good metal worker, by all means make them of brass, for then you can have the stamp of lighter pattern. If of wood, they should be painted to represent antique bronze, using yellow ochre, green and black. They will stand on the after end of the cow bridge.

Right aft there should be a basket lantern on a bracket. The lantern can be made from strips of metal soldered, but cardboard is easier to use. Shave the end of a round stick to form a mold for the inside of the lantern; over the end of this lay three strips, holding their ends evenly in position with a rubber band. Around these glue three other strips, clipping their overlapping ends together with clamps or other bands. When this is dry, slip the stick out and there is your basket. Put a very thin piece of paper around the stick first, so that the strips will not be glued fast to it.

In the bottom of the basket set a thin piece of wood. The bracket may be of wood (as shown on Blueprint No. 75), it is nailed to the deck and glued to the bulwark. The basket is nailed to the outer end of the bracket.

The small boat is $4\frac{1}{2}$ in. long, $1\frac{1}{2}$ in. wide and $\frac{1}{4}$ in. deep. It is double-ended with a big sheer. The keel and ribs, all in one curve, may be left on in the cutting, or a piece of spline may be nailed on. The boat should be hollowed out as thin as possible, with round ends and four thwart. It may be fitted with oars and painter. At each end there should be a single block stapled to the solid parts. It may be painted antique white, bluish white inside, with brown thwarts and gunwales, the latter being bored for oar holes.

There will be four anchors. These may be bought ready made, cast from bronze or lead, or cut from the latter. (Continued on page 95)



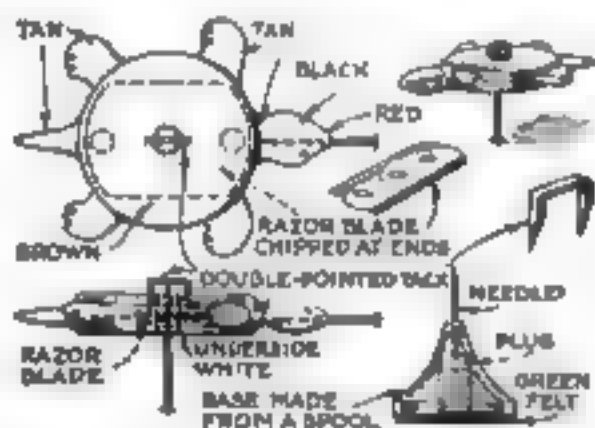
A section through the stern superstructure and details of fore-castle and after-castle.

This Little Turtle Always Heads North

By F. CLARKE HUGHES

THE turtle compass illustrated below is made of two pieces of soft wood, each approximately $\frac{1}{2}$ by $1\frac{1}{2}$ by $2\frac{1}{2}$ in., cut to the shape shown. Round the legs, tail and head, as indicated in the side view, and drill a $\frac{1}{8}$ -in. hole through the center.

A double-edged razor blade of the type having a hole through the center is chipped or broken at the ends to fit the body of the turtle. Magnetize the blade by drawing it a few times across the poles of an electromagnet. Then determine which is the north pole end by placing it



Top and edge views of the turtle, the stand, and sketch showing compass set on a pin

temporarily in place and balancing the turtle on a pin point.

Glue the two halves together with the razor blade sandwiched between. Have the north pole end toward the head. Twine may be bound around the model while the glue is setting.

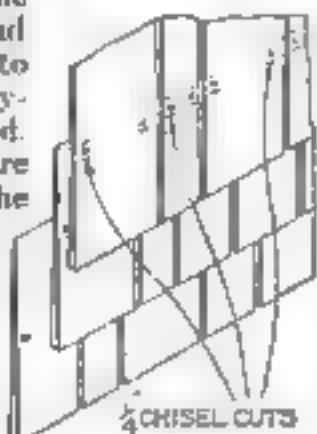
A double-pointed tack for the pivot completes the compass, although it is necessary to make a stand of some kind.

The turtle also may be used as a pocket compass if a small hole is drilled into the mouth and a pin stored in it. When the compass is to be used, the pin is withdrawn and the turtle balanced upon it.

Paint the turtle in tones of brown or tan or other dull colors with the underside white or light in color.

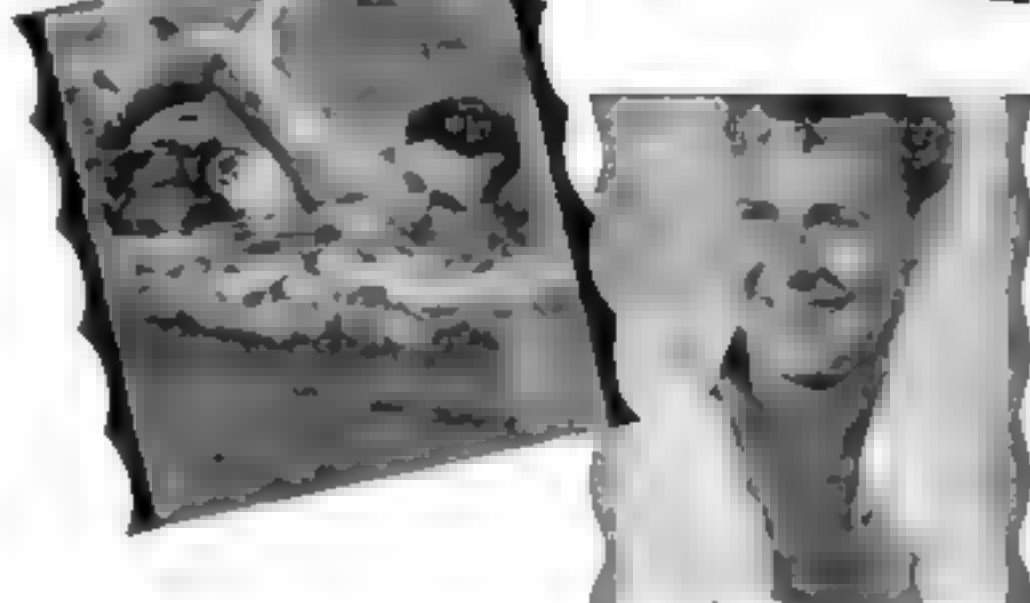
How to Remove Shingles Neatly

WOODEN shingles and the nails holding them can be removed easily and quickly from a building, with no damage to the shingles, by puncturing each shingle directly above and below each nailhead with a $\frac{1}{4}$ -in. chisel. This severs the grain of the wood crosswise and allows the shingle to be removed by prying up the butt end. The nails, which are left protruding the thickness of the shingle, can be drawn without difficulty. This is an improvement over the method of punching the nails through the shingle.—A.M.G.



After being chiseled, the shingles are pried off

even a swim



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IF a Turkish bath won't clean our pore-dirt, you'll see how little chance you have of losing it with ordinary cleansing methods.

For pore-dirt is grimed down deep in every face. It's under the surface. There it clings—grays your complexion, dulls your skin, robs you of the healthy, athletic glow that a really clean face radiates.

How does it get there? The air about you all day long is teeming with millions of tiny specks of gray. They come from smoking chimneys, dusty streets, passing motors. They're too small to see. So tiny, in fact, that they work unnoticed into the pores—get packed down where the wash-cloth never reaches them.

"Not in my face," you say. Yes, in *your* face—in every face. Here's proof: Send for a *free* tube of Pompeian Massage Cream. When it comes, rub a small amount of the cream into your face.

Then note this amazing thing—

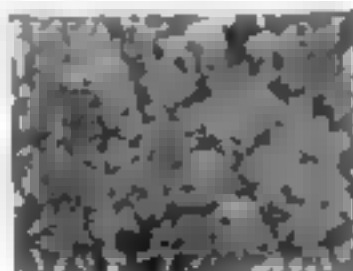
Goes in pink; ROLLS OUT GRAY

The upper of these two photomicrographs shows a section of skin before using Pompeian Massage Cream. Compare it with the lower picture, taken after using Pompeian. There's skin that IS clean! Those gray marks are the dried pellets of cream—dark with the pore-dirt that has been rolled free.

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Photomicrograph taken under the lens of powerful microscope showing section of skin before using Pompeian Massage Cream.



Photomicrograph of skin after using Pompeian. Compare the skin zone. Note the dried pellets of cream, dark with pore-dirt that has been rolled free.

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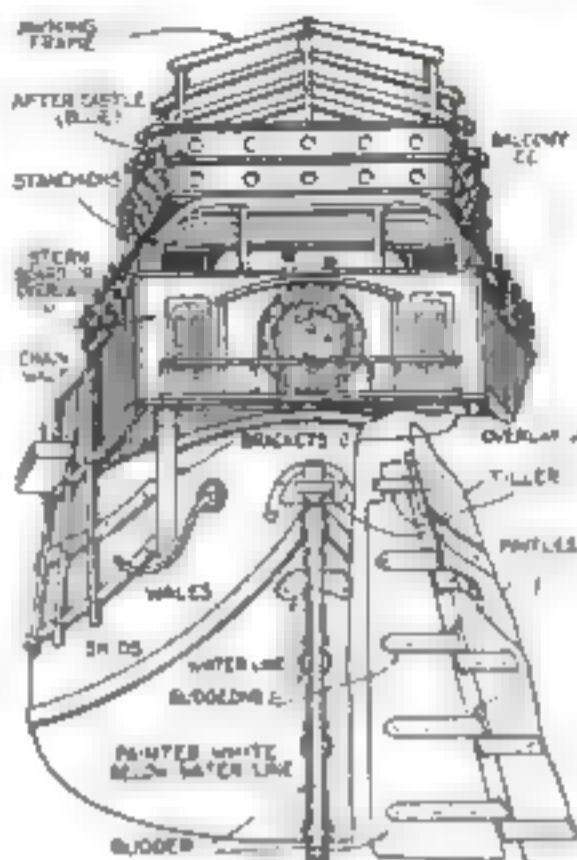
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The True Santa Maria

(Continued from page 94)



Comparing this view and the photograph on page 78 will make clear the steps construction.

The forward ones will be 1½ in. long; the after 1½ in. or less. They will have wooden stocks, made by cutting the stock to shape, then splitting it down the center, fitting it to the shank and gluing it in place with thread bindings. The stocks will be very dark brown and the metal parts bronze.

Across the stern there may be a little balcony. It is a thin platform ½ in. wide by 4½ in. long. On each corner erect a ½-in. post, ¼ in. high, onto these glue and nail a very thin handrail, half-lapped at the corners, and connect the rail to the platform, between posts, with thin round sticks. Bore right through the platform and halfway through the handrail for these. Glue and nail the balcony from underneath to the sternboard at its lower edge, so that the platform will slope with the sheer of the ship. This can be placed in position when made.

THE hawse pipes for the forward anchors are ½ in. holes, 1½ in. from the stem, between the first and second wales. They should have wickets or grooves (glue and whitening) rims. The cut holes for the after-anchor cables are smaller holes, 1 in. from the stem and ½ in. above the lowest wale (in line with the tiller).

There should be circular mooring posts on

either side, just above the level of the main deck and near its extremities; these also should have lips. They are for mooring ropes and to let the water off the deck.

The rudder can be seen on page 78 and in the sheer plan on Blueprint No. 74. It is the same thickness as the sternpost and extends 4 in. up from the keel line. The top is cut square to take the tiller, which fits on it and extends into the hull, through a semicircular hole, with its lower edge 3½ in. up from the keel. The rudder may be hung with double-pointed nails driven into it and the sternpost or with regular pintles and gudgeons. The pintles may be made from thin brass or tin, the strips are then brought around the edges and nailed to the flat of the rudder. The gudgeons are similar, except that the nails are withdrawn, leaving holes for the pindle nails to fit into; they are nailed in the sternpost, so that both parts be horizontal. The lower edge of the pindle straps coincides with the upper edge of the gudgeon straps, allowing the rudder to turn.

A good compromise method is to make eyes from pins and books from other pins and drive them into the edges of the sternpost and rudder respectively.

The hull may now be finally colored. An antique effect for this model is desirable. This antiquing is difficult to describe and the result will necessarily depend considerably on the builder.

The lower part to the water line should be white, but with a lot of Vandyke brown rubbed in, with here and there touches of raw sienna, green and a minute amount of red.

THE upper parts outside will be various shades of brown stain. I used mahogany and old oak stain, both separately and blended, to get a rich effect, with here and there some verdigris green (artist's oil color) rubbed in. The skids I made the darkest and on the wales I rubbed some Harrison red to look as if they had once been painted red but most of the color had been rubbed off. For all decks and uprights, I used an irregular and lighter shade of brown, making the uprights and skids always darker than the decks.

When all the coloring is done, the whole (excepting the white) may be given a thin coat of varnish—enough to bring up the color but not to make anything shiny. Shiny parts should be rubbed flat with pumice-stone powder.

With the exception of the shields, flags and top, there is nothing to do now but the rigging and sails, so in the February issue we shall proceed to untangle this complicated-looking but not really difficult mass.

You will by now find that your *Santa Maria* is becoming interesting, good looking and well worth the work you have put into her.

Easy-to-Build Furniture

(Continued from page 75)

the edges, nail in place the back, which is ¾ by 14½ by 22½ in. Plywood preferably should be used for the back. Plane it flush on all edges.

The sides, ¾ by 8½ by 22½ in., which should also be made of plywood, are then nailed in place with very thin finishing nails. These should be set slightly below the surface with a nail set, and the holes filled with plastic wood filler, water putty, gesso or stick shellac.

After planing the edges of the sides flush on the front, back, top and bottom, nail on the front edges two small strips 6, ¾ by 1 by 22½ in., to conceal the joints of the frames, the shelves and the plywood sides.

The front baseboard is shaped as shown in detail on Blueprint No. 77 and mitered at the corners to meet the side baseboard pieces. The base molding and the top molding may be bought ready-made, mitered at the corners and nailed in place.

The pediment is laid out as shown on the blueprint and fastened to the top by means of dowels or small cleats.

The door, which is ¾ by 13 by 10 in., is planed to fit the opening exactly and fastened with two 1-in. butt hinges. A ball catch is a convenient locking device, and one brass knob is needed.

Before undertaking (Continued on page 97)

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The cigarette you can be fond of . . .

SEEK and search wherever you will, you'll never find a smoke like Camel. So loyal and so fine. Camels reveal the delicate tastes and fragrances of the choicest tobaccos grown. That is why they never tire. Why each succeeding Camel tastes more smooth and mellowly mild.

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Easy-to-Build Furniture

(Continued from page 96)

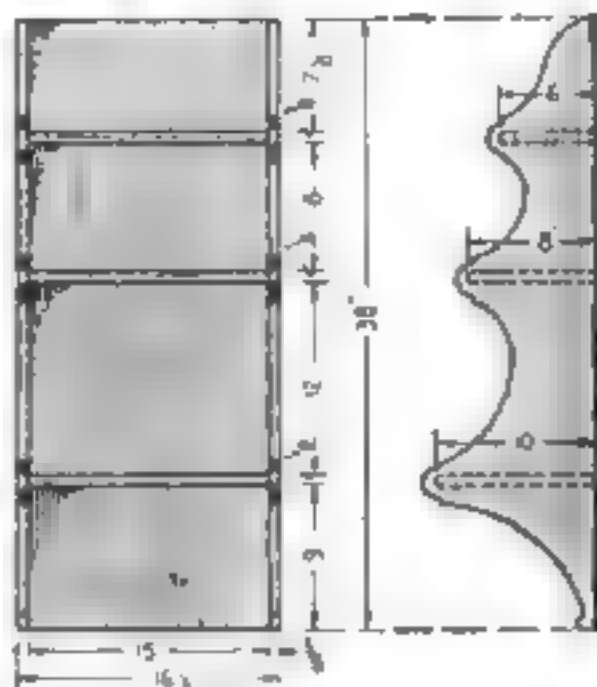
the construction of the cabinet, measure the books which it is to hold. While the spacing of the shelves shown on page 73 is especially pleasing from the standpoint of design, it may not be suitable for the books which the cabinet is intended to contain. If a large set of uniform volumes are to be placed in the case, two or more shelves may be required to accommodate them. In such a case these shelves should be spaced alike and the remaining space divided to suit the rest of the collection. In general, however, it should be remembered that the larger spaces should be toward the bottom.

The hanging bookshelves are so simple in construction as to need very little explanation, especially as the method for laying out the curves exactly is given on Blueprint No. 77.

The sides are cut with a turning saw, unless it is convenient to have them hand-sawed at a woodworking shop. They are finished with a spokeshave, file and sandpaper. The three shelves should be cut exactly the same length and the ends must be perfectly square to insure a good joint. The easiest way to assemble the parts is to nail or screw them together, but they also may be glued together with dowsels.

The back, which should be of plywood, if possible, is nailed to the sides and shelves; it adds materially to the strength and stability of the construction. Again, do not overlook measuring the books which are to be placed on the shelves and if necessary change the spacing slightly to suit the height of the volumes.

THE corner shed, which is illustrated on the blueprint, is designed, as the name implies, to hang in a corner. It may be used as a handy depository for a variety of objects. Indeed, this type of furniture is often given the characteristic name of "whatnot." It is suggested that plywood be used throughout for it because this comes in an even thickness from the mill



Front and side views of the hanging bookshelves. How to make a pattern for marking the end pieces is shown on Blueprint 77.

all ready to be cut to shape and put together. The method of fastening the sides and shelves is identical with that described for the hanging shelves.

The modern method of finishing pieces such as this is to give them two or three coats of brushing lacquer. Usually a trimming roller is used on the edges or elsewhere. Transfer designs are sometimes applied and stippling and blending used, as described in an article, "New Ways to Paint Furniture," on page 73 of the September, 1927, issue, and in other recent articles in *POPULAR SCIENCE MONTHLY*.

Staining and shellacking or waxing also may be employed as a finish, as plywood of the better grade often shows a beautiful grain.

Building the Set

(Continued from page 91)

to make the whole setting stand up firmly.

Since we are dealing with simple materials we can also make our carpentry simple. I have found that the easiest way to join the frames is by means of a butt joint held together by corrugated fasteners. Those of my readers who have never yet met a corrugated fastener by all means should hasten to the nearest hardware store and be introduced to these most convenient and ingenious labor savers.

Before illustrating the simple art of frame

building and covering, I must go back again to the stage model. In a previous article I described a simple method of making models.

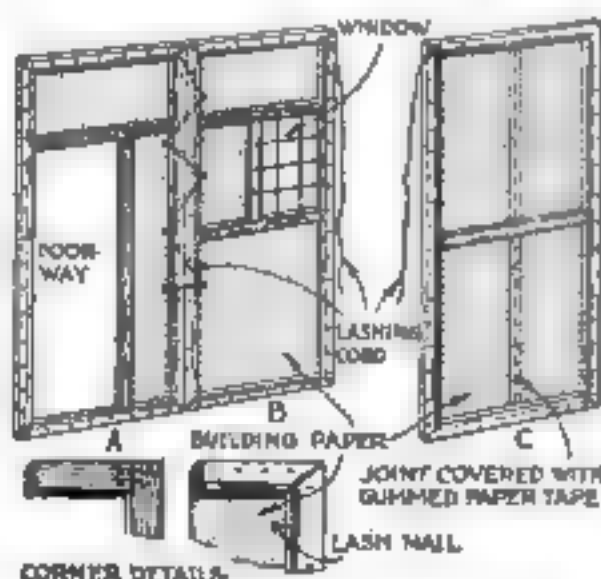
THE process of enlarging the model is best accomplished by making a set of so-called working drawings, that is, scale floor plans and the faces or "elevations" of the walls of the room. On these plans and elevations the scene-wright must indicate accurately the measurements of the frames, the framing of door and window openings, and any other structural features. If he wishes to omit this step in the work, he can use the back of the model, provided it has been made accurately to scale.

When I speak of wall sections I do not mean the entire side of a room, but the sections into which the various walls of the room are divided. Very often for a two-act play the first act set can be placed inside the second act set. In that case the first act set should be designed in such a way as to be easily removed, leaving, if possible, the second, or permanent, set, ready for the furniture change. Speed in scene shifting is a most essential requirement.

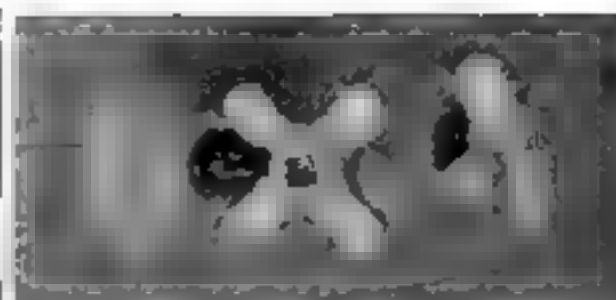
I have found it better to divide the wall sections into what one might call one-man flats, that is, not exceeding five feet in width, so that a man can easily lift one and walk off with it alone.

At A and B in the illustration on page 97, two of the more common frames are shown, A containing a door opening and B a window. In these simple sets

(Continued on page 98)



How typical frames are constructed of framing strips and covered with building paper.



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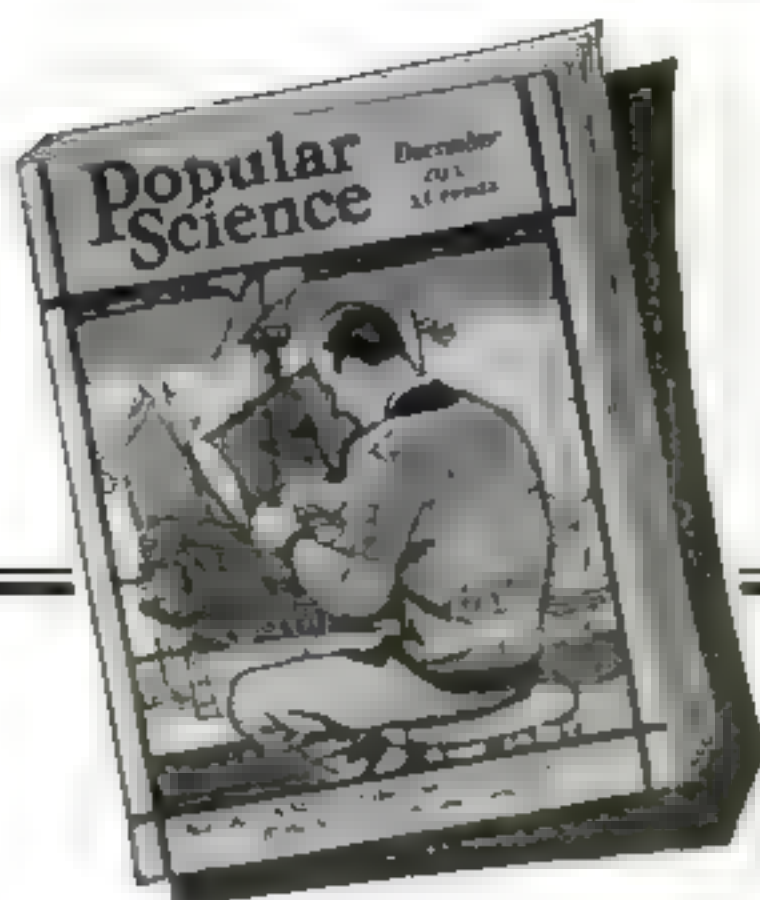
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Building the Set

(Continued from page 97)

no attempt will be made to suggest the structural thickness of a wall.

In covering the frames with paper the builder must be sure to allow enough paper all around the frame to lap over the edges. To make a tight job, the paper should be tacked on the back of the frame, never on the front face or the side edges. Building paper comes in rolls three feet wide. If the frames to be covered are wider than two feet six inches, two widths of paper must be joined. The best way to do this is to lay the paper down on the floor, edge to edge but not overlapping, and run over the joint a strip of gummed paper (tape) or sticker paper. Now place the frame on top of these joined sheets and proceed as before, taping the paper over the edges and tacking it to the back face of the frame.

IN THE average frame containing a window or a door the vertical and horizontal strips forming these openings will serve to brace the frames, but in "flats" (frames without openings), it is well to brace these with a horizontal crossbar as shown at C. Only on large frames, such as backdrops, is it necessary to employ corner bracing.

In case the play calls for a practical or workable door, it will be necessary to provide a door frame independent of the wall frames and secured in place by braces running to the floor, or, if the actual backstage ceiling is low enough, it can be fastened to the ceiling so as to avoid the awkwardness of projecting floor braces, especially where the backstage floor area is limited. A small light door can be framed of furring strips, covered on both sides and painted to represent boarding or panels. In this case the door can be hinged to the opening in the scene frame. But these doors are rarely practical in that they are apt to swing unevenly or catch on the floor owing to the walls of the setting being out of plumb. It is always good practice to use real doors and frames.

AFTER the frames are made and covered, provision should be made for lashing them in place. A stout cord should be nailed to the upper right-hand corner of each frame, and below it and on the adjoining frame roofing nails should be driven partly into the inside edges of the frames. These are staggered so that the lash rope will sign down the two frames as illustrated to a point about two feet six inches above the floor.

In order to suggest door and window frames, a chair rail, the top rail of a wainscot or the baseboard of a room, building paper can be used to good advantage by folding it into strips of the desired width and tacking them into position.

Having provided for the side walls, we need only add a ceiling in order to complete our set. On many small stages the actual stage ceiling is low enough to serve for the ceiling of the set. The frames are then made to fit securely between the floor and ceiling. But if the backstage ceiling is too high for actual use, a false ceiling or "lid" must be provided to fit over the top of the setting. This can be done by making a large rectangular one-piece frame and covering it with muslin, or it can be so constructed that the frame can be bolted together at the corners and at a middle brace. The two shorter side pieces and the middle brace are thus easily removed and the entire ceiling rolled up for convenient storage. It stands to reason that in this second and more practical type of ceiling the muslin is tacked only to the two longer sides of the frame. This false ceiling should be hung from the actual stage ceiling by ropes and pulleys.

In his next article Mr. Smith will discuss simple methods of scene painting.

Ways to Paint Chairs

(Continued from page 77)

In applying each of the coats, turn the chair upside down and do the legs first. Then right the chair and work down from the top, doing the seat last.

For doing the spokes or rounds, a 1-in. camel-hair brush is generally found most satisfactory, as it is very soft and will fit closely around the spoke or round. For the seat, back panel, arms and larger surfaces, a larger brush should be used—about a 1 1/2-in. or 2-in. flat or bear hair. For the trim, use a small camel-hair pencil brush or a 3/4-in. soft-haired brush.

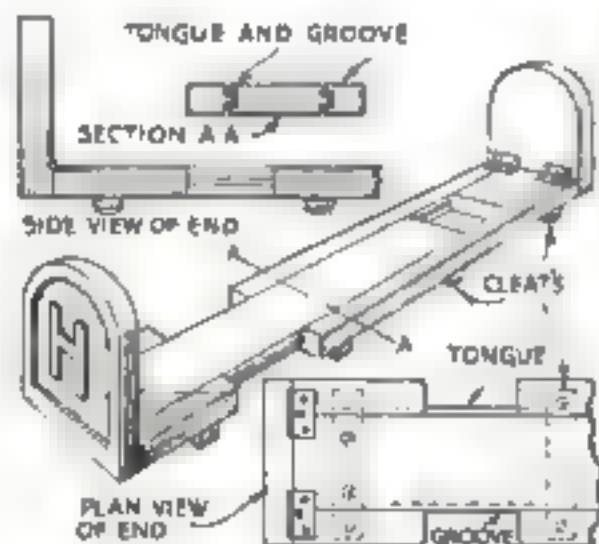
The parts of the chair that are to have a trim color may be left when putting on the body color of lacquer or enamel, although for an enamel finish the undercoat should be applied over the entire surface. Especially in lacquering it is preferable not to apply the body coat over the parts that are to have trim color for the reason that the powerful lacquer solvents soften undercoatings; when one shade is applied over another, the colors may run and disfigure the job.

IN MANY cases the design is such that the use of transfer patterns or stenciled designs appropriately placed will add a most pleasing touch to the chair.

The finishing of furniture is a profession that painters have spent years in mastering, and the amateur craftsman who is making a study of this fine craft learns something new with every job, improving both his technique and the finished result.

This is the fourth in a series of articles on modern ways to paint furniture. The previous articles were "How to Apply Art Transfers," July, 1927, issue; "New Ways to Paint Furniture—A Magazine Rack," September, 1927, and "Five Ways to Paint Tilt-Top Tables," November, 1927. The next topic Mr. Elliot will discuss is the decoration of breakfast sets.

Adjustable Book Stand

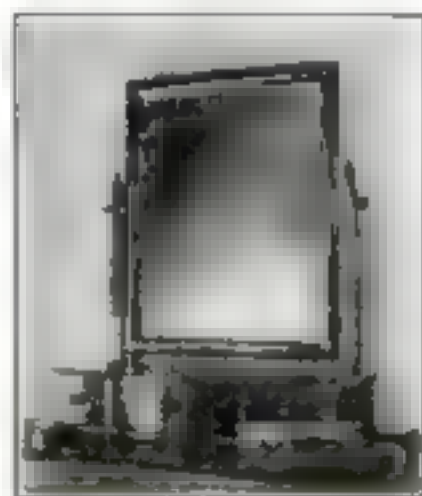


The ends of this book stand can be folded down to save space when it is to be stored away.

IN THIS day of the sectional bookcase, those of us who are gradually accumulating a library add a section from time to time. Even then there comes a "time between" when the bookcase is filled up and we have a few books over. It was such a time that prompted me to build the book stand illustrated, which is made of white pine, the base being tongue-and-grooved stock (flooring). The end pieces are 1 in. thick, 7 in. wide and 6 in. high; the center slide is 4 in. wide, and the pieces on each side of it are 1 3/4 in. wide. It provides a book capacity from 24 to 36 in.—J. P. HARDY.



DRESSING CABINET
See LePage's Book, page 13



DRESSING GLASS
See LePage's Book, page 21

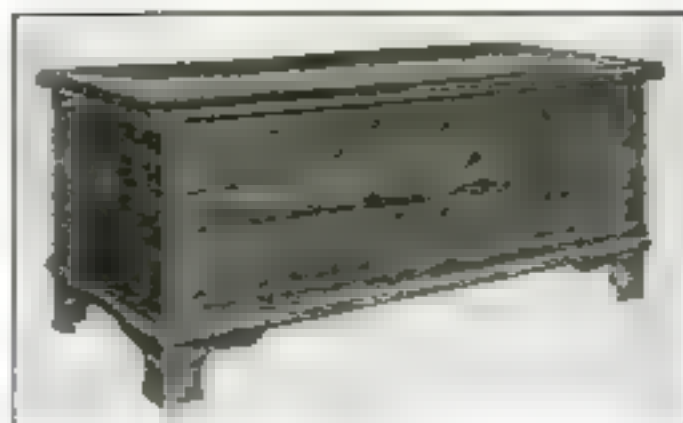


HANGING BOOK SHELVES
See LePage's Book, page 25



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CEDAR CHEST
See LePage's Book, page 12

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How to Make a Strong Combination Kitchen Stool and Pantry Steps

By CHARLES A. KING

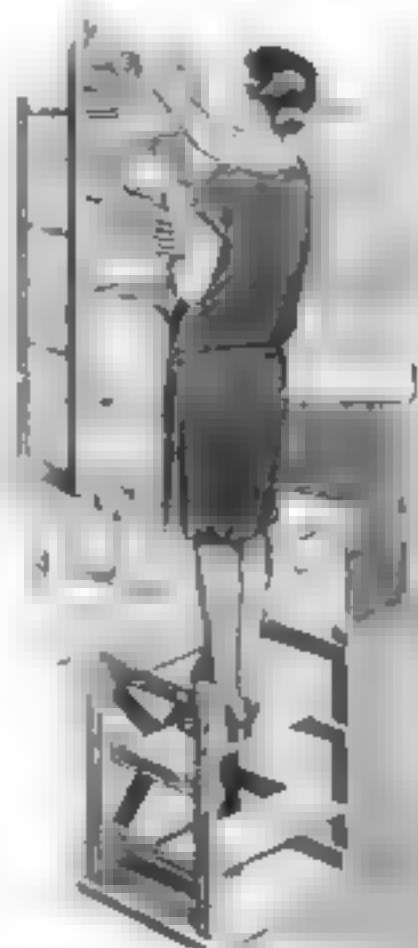
KITCHEN stool and pantry steps are combined in the useful piece of household furniture illustrated at right. Because of its broad bearing on the floor and its well braced and substantial although simple construction, it has to a marked degree the strength and rigidity necessary to insure the safety of those who use it.

Any moderately hard wood such as birch, maple, ash, elm, spruce or white-wood may be used. The boards from which the legs are to be cut may be $\frac{3}{4}$ in. thick, if $\frac{1}{2}$ in. stock is not available. The $\frac{5}{8}$ by 1 $\frac{1}{2}$ -in. ledgers or crosspieces should be grooved and shouldered as at A, Fig. 1, and the legs notched as at B, Fig. 2. They are fastened with glue and 1-in. No. 9 screws.

The $\frac{3}{4}$ -in. steps and top or seat may be fastened with 1 $\frac{1}{2}$ -in. No. 15 brads set well below the surface. Hold the braces in place by 1 $\frac{1}{4}$ -in. No. 9 round-head screws driven through the back legs into the braces as at C.

Be sure the assembled step seat is accurately squared before the back braces are fitted.

Round all sharp corners with No. 1 $\frac{1}{2}$ sandpaper and finish with two coats of



For reaching high shelves in a kitchen cupboard or pantry and for other uses, these steps are more convenient than a ladder.

varnish, if preferred, stain, shellac and varnish may be used, or, of course, colored brushing lacquer.

If four polished metal furniture slides are driven into the top of the stool, close to the corners, they will protect the finish when the stool is turned up for use as a stepladder. They will also give a firm bearing even on a slightly irregular floor. The same effect can be obtained by hollowing the upper edges of the top rail so that the top of the stool, when turned downward on the floor, will rest only on its outer edges.

Preparing an Outdoor Rink

THE secret of making a good outdoor rink for ice skating is to spray the water on as if watering a lawn. When the ground is flooded too rapidly some of the water is apt to drain off after the ice has begun to form and the thin shell of surface ice soon breaks. It is best to use a $\frac{1}{4}$ -in. hose with a nozzle that can be regulated to give a mist spray.

Before starting, however, construct a dike around the selected area, using earth of a clayey nature, snow, or heavy planks set into the ground a few inches. A snow dike should be soaked with water and allowed to freeze solidly.

Skating can begin after a sheet of ice 1 in. thick has been formed, but the spraying should be continued on every cold night until the ice is five or six inches thick.—L. T. J.

Hand-Wrought Hardware

(Continued from page 80)

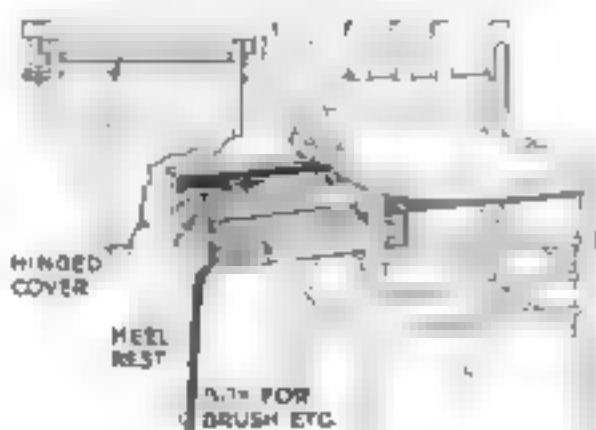
in-japan and then it with turpentine. Apply this flat black coat, let it dry an hour or so, and then gently wipe off the surface with the idea of removing all the black except what remains in the deep pits and hammer marks. If the surface seems very dry, moisten the cloth with gasoline or turpentine, but be careful not to wipe hard or you will remove all the black or smear it around in an uninteresting manner. Then let the black dry overnight and gently wash the surface with a clean cloth wet with gasoline to clear up the light metal areas. Let dry and apply two or three coats of clear brushing lacquer and the job is done.

Obviously the common flat- or round-head screws are not suitable for such hinges. It was found impossible to get lag screws (screws with square heads like machine bolts) which were short enough to put into wood walls only $\frac{3}{4}$ in. thick. Lag screws $1\frac{1}{4}$ in. long were the smallest to be found, so they were cut off with a hack saw and sharpened a little on the end to point them up. Then, to make sure they took hold of the wood, a small hole was drilled first and one of the long, uncut lag screws was started into the hole and backed out, forming threads in the wood. The short screws then took hold well and made a secure job. The square heads were finished in flat black and clear lacquer only—no silver ground.

Other hardware on this desk was finished in the same way. The door knobs were brass of a smooth type, but were hammered and finished like the hinges. Braces were made of strap iron $\frac{3}{4}$ by $\frac{1}{2}$ in., heated in a hard-coal water-tank-heater stove and bent in a vise.

Mr. Vanderwalker told how he made the desk itself from odds and ends of lumber and painted and glazed the wood in an article published last month in POPULAR SCIENCE MONTHLY (page 81).

Shoe Shining Attachment for Kitchen Chair



A one-legged stand is built to slide under the seat of a kitchen chair when not in use.

IN A small kitchen where there is little room for a shoe shining stand of the usual type, a sliding attachment may be fastened as shown under the seat of a heavily built kitchen chair. To prevent the stand from coming out too far, a large screw is driven into the side of the box toward the rear and another into one of the slides near the front, so that the two screws cannot pass each other.

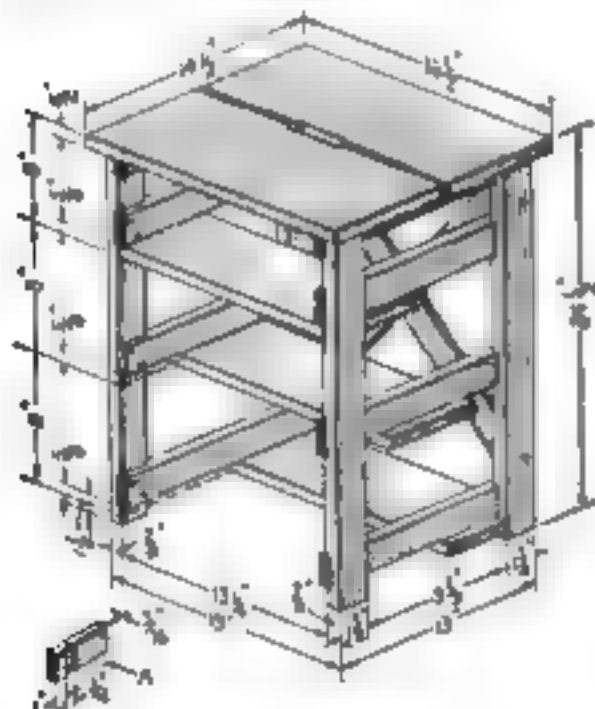


Fig. 1. How completed steps look when used as a stool. Compare with Fig. 2, just below.

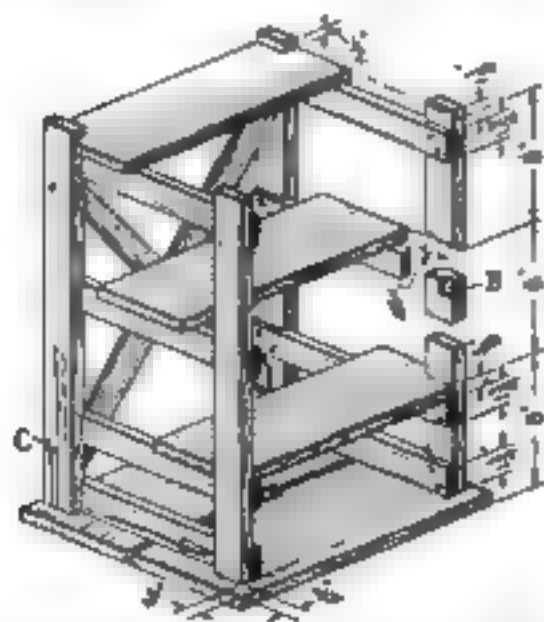


Fig. 2. The construction of the steps. Note particularly the notches (B) for the ledgers.

Build for Utility First in Home

(Continued from page 66)

diversity of materials makes the house interesting. Others maintain that the eye is in time fatigued by a multiplicity of effects.

Jazz architecture in small houses has been carried to the ultimate in a certain Eastern development. Lugs, rough masonry and prim brickwork, hand-wrought iron, things most ancient and very new, hues sumber and violently vivid, are commingled with a degree of masterful artistry.

Apart from the art question, jazz building costs more for labor and materials.

Of course, no one can criticize the legitimate present-day development that is giving form, color, and life to the modern house. American homes have tended in the past toward a drab uniformity and blank simplicity. They are entitled to a modicum of genuine style and to touching up of their complexions, so to speak, with a few sprightly hues.

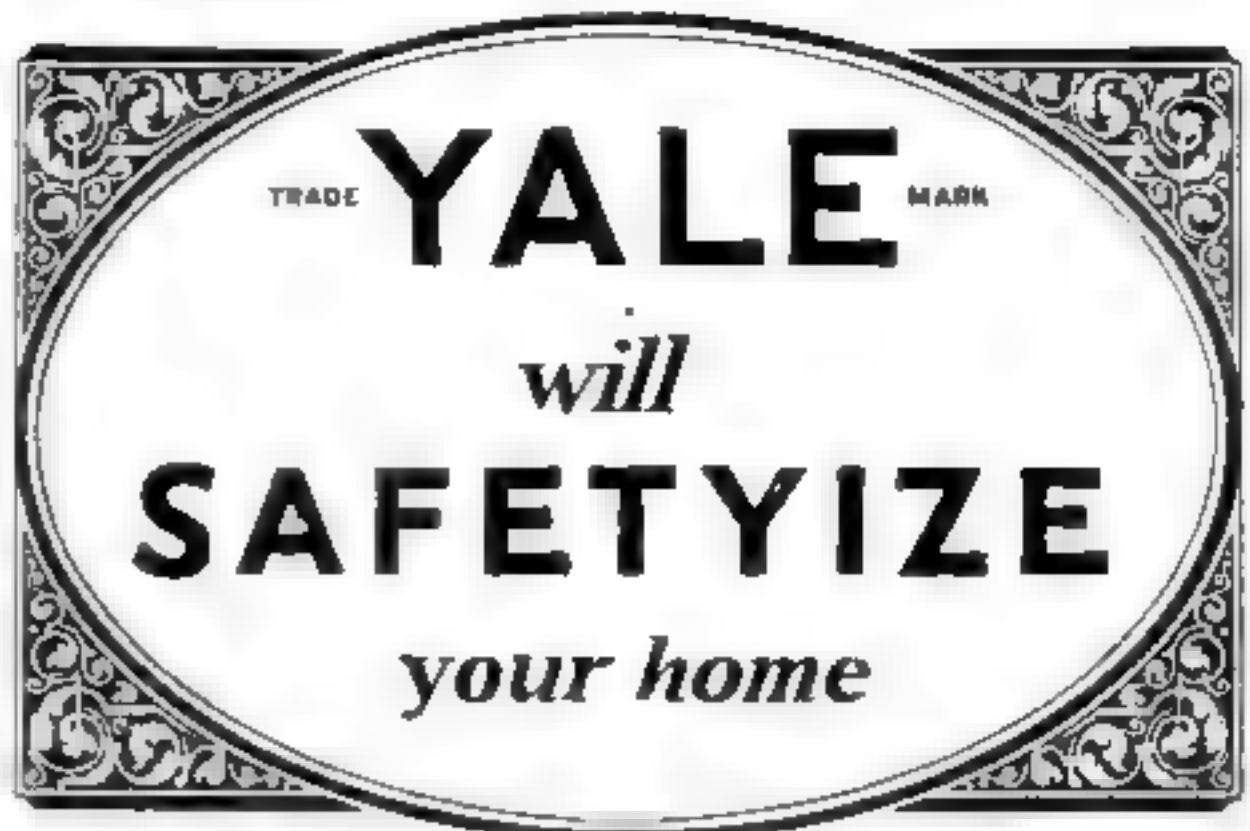
IN OUR youth we were proud of our new house. We now learn that a new house must appear to be as old established as possible. There is quite a technique of ageing. Second-hand bricks and weatherbeaten old timbers set in exposed positions are helpful. For a gable end unpainted rough clapboards are burned at random with a blowtorch. Slates of irregular size and chance colors are applied to the roof, and often the workman is instructed to squab their ends here and there.

Most persons cannot afford the luxury of ageing, at least in its extreme forms. For example, a slate roof made for decorative smashing is generally extra heavy and backed by thick waterproof asphalt roofing. It is safe against leakage regardless of cruel treatment of the surface. Ordinary thin slate would not stand the punishment. Again, the unpainted burned clapboards are probably cypress or another wood capable of enduring weather.

While wood frame still leads in American home construction, there has been a considerable increase within recent years in dwellings of brick, hallow tile, concrete masonry and stucco. A great deal of stucco is now applied on metal lath over wood frame, while it is directly laid on hallow tile and concrete blocks. It should be backed with asphalt roofing beneath lath in the case of wood frame. Stucco is put on with deceptive ease, and any kind of a job passes muster for a short time, but for permanent success the greatest precautions must be taken. The formula for a good mixture is one bag of Portland cement to three cubic feet of sand, with not more than eight pounds of hydrated lime and nine pounds of approved coloring matter. Two or three coats may be put on, the finish coat about a week after its predecessor. Uniformity of color depends on exact mixing and using the same kind of sand throughout. Half a dozen textural finishes are obtained by troweling, by roughening the surface with a hurlap bag and by throwing handfuls of gravel forcibly against the soft surface. A most important detail of the stucco recipe is to cure the material by keeping the finished wall damp for at least a week.

STUCCO is yet the preferred outside finish for a house of concrete masonry. However, the authorities seem to have receded from the position that nothing else will do. If concrete blocks have a dense waterproofing, are well pointed in mortar joints and have a tasteful appearance—smooth or slightly ribbed—they may be left exposed. It is mainly a question of looks.

That looks count is shown by the increasing vogue of brick, which is attributed largely to the attractive small house designs made for this material. Through skillful treatment the brick house has become informal, varied, graceful and even cozy.



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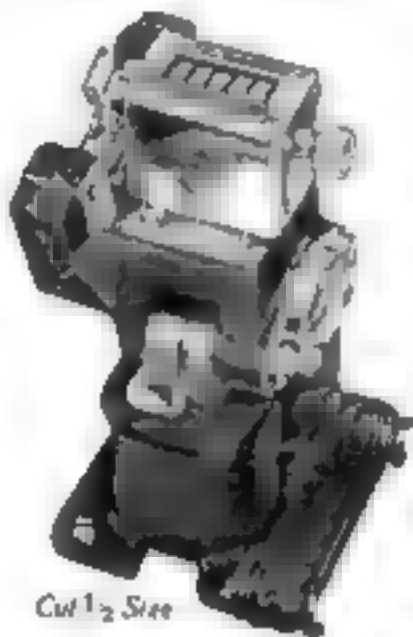
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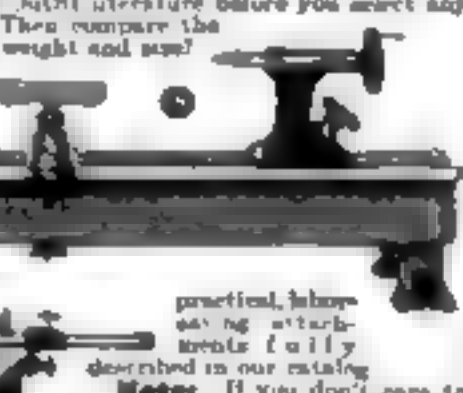
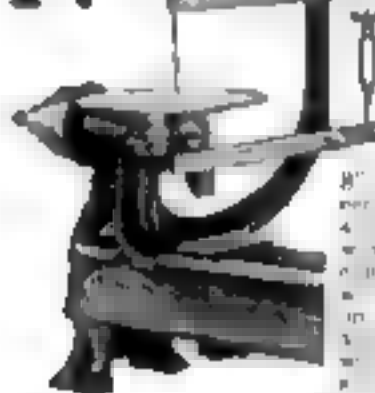
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Two Useful Pieces Built from an Old Chiffonier

By WINSOR R. DAVIS



This commodious child's wardrobe was made from part of a discarded chiffonier

IN ALMOST every family there is an old-fashioned high chiffonier with a mirror that has been consigned to the attic, and nearly all secondhand furniture stores have such pieces for sale at low prices. At a cost of not more than five dollars you can convert a chiffonier of this style into an up-to-date wardrobe and an attractive dressing table.

The wardrobe and dresser illustrated were made for a little girl's room. While the plan is best suited, perhaps, for nursery furniture, it could be used with but slight modification for any bedroom.

Mirror and frame, drawers, and all front cross members, except those directly above the bottom drawer, are removed. As chiffonier dimensions vary, you may find it advisable to remove the bottom drawer also and make the wardrobe doors full length. This would be necessary in a wardrobe for the use of older children or in one to accommodate men's suits.

A rod may be suspended from the top to take the garment hangers, but it is much more convenient to place the rod in a frame which can be pulled out when the doors are open. The front of the frame is made from one of the stretcher pieces; its over-all length should be $\frac{3}{4}$ in. less than the width of the opening. The side members are made from two of the drawer slides and the back is cut from the back

of one of the drawers. Before assembling, drill a hole in each sidepiece and insert the rod.

Stand the wardrobe upside down, cut two pieces of the original drawer slide stock to correct length, and screw them to the top of the wardrobe so as to form guides for the hanger frame.

Small wooden clothes hangers with the wire loop cut shorter and bent smaller are more suitable for use with this frame than are regular hangers.

The doors, which fit inside the wardrobe opening, are conventional cabinet doors, which any mill supply house can furnish (possibly from stock), but you can make them yourself if you prefer. The doors are hung with butt hinges, and spring ball-and-socket catches are inserted at the bottom of each door to keep it closed.

The tray, which slips in the bottom of the compartment where the clothes are hung, is made by sawing off one of the drawers 3 in. from the bottom and planing the top edges.

Sandpaper and shellac the inside of the wardrobe and the tray and finish the outside with lacquer, paint or enamel.

The dresser is even easier to make. The top is an inverted drawer. Its front is placed to form the back of the dresser in order to give a heavy base to which the



The completed dresser gives no indication that it is really an old drawer set on legs

mirror support can be securely fastened.

Make four straight legs $1\frac{1}{4}$ or $1\frac{3}{4}$ in. square and screw them inside the corners of the drawer. For a child's use, the dresser should have legs about 27 in. long. If your chiffonier has provided you with a small drawer, this can be hung underneath by using the drawer slides. The piece from which the drawer is hung must be long enough to be screwed to the front and back of the drawer that forms the dresser top.

The sides of the inverted drawer, which are raised about $\frac{1}{4}$ in. above the top surface, form just the frame needed if you wish to use a glass top.

The under part of the dresser is concealed with cretonne or other material, divided to give access to the drawer.

Pipe Fittings Used to Make Andirons



Fig. 1. A pair of fire dogs made of pipe fittings by W. S. Pickrell, of Spokane, Wash.

THE andirons illustrated in Fig. 2 are suitable for any fireplace and especially for one in a log cabin or camp. Separate andirons have a tendency to move about when the fire is being built or rebuilt, but this one-piece set eliminates that.

The materials may be found in any pipe fitting shop or wherever considerable pipe fitting is being done. Although planned for 1-in. pipe, the andirons may be changed in dimensions for pipe of another size, or any desired adaptation may be made in the over-all dimensions.

Standard malleable fittings may be used, but the rail fittings shown will look a little better. If the couplings and the ball or acorn top are of brass and kept polished, they will add much to the appearance of the andirons.

The following 1-in. pipe and fittings will be required: 4 nipples A, threaded

one end, $4\frac{1}{2}$ in. long ($\frac{3}{4}$ in. allowed on each end for thread); 2 nipples B, threaded both ends, 14 in. long; 2 nipples C, threaded both ends, 8 in. long; 2 nipples D, threaded both ends, $4\frac{1}{2}$ in. long; 1 nipple E, threaded both ends, $8\frac{1}{2}$ in. long; 2 couplings F (may be of brass); 4 elbows G; 2 tees, side outlet, H; 2 acorn or ball tops, male, K (may be of brass). All joints should be turned off hard.

If separate andirons of the more conventional type are preferred, they may be made as shown in Fig. 1. These neat and sturdy andirons are the work of W. S. Pickrell, of Spokane, Wash. They are of 1-in. pipe and fittings. The balls and the four-way tees are handrail parts.

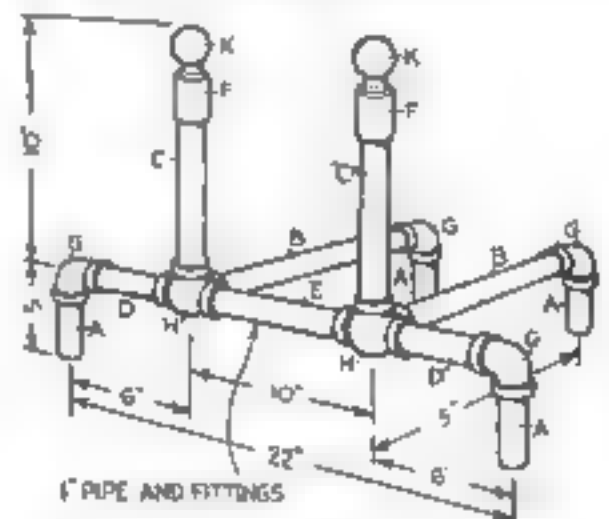
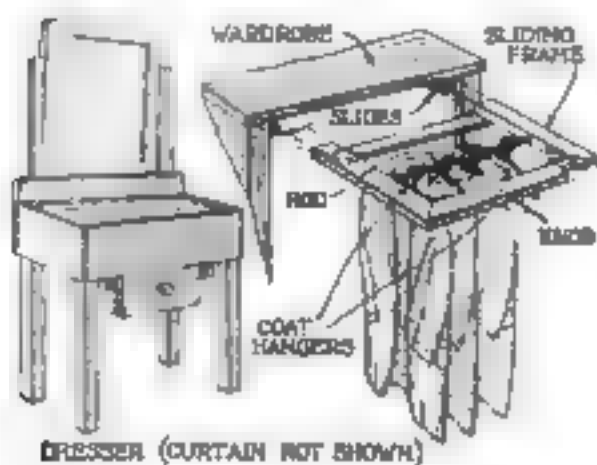


Fig. 2. A set of sturdy andirons built in one piece of 1-inch pipe and handrail fittings



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that comes with every kit. Take part #37 place it at the front end of #36 and down on #33. Next take part #38 and place it at the rear end of #36 and tap in place with a small hammer.

So clear are the instructions that the 15-year-old boy pictured above won First Prize in a model contest held by the publishers of Science & Invention Magazine. Hundreds of ship models were entered from all parts of the country. This model was constructed from a regular kit of our parts. The educational and historical value a boy gains in constructing one of these models

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boys, but make a beautiful gift for everyone. Doctors, Lawyers, Business Men, Nurses, Stenographers and Housewives all over the country have built models from our complete kit of parts. They have become so interested in building the first model that, in many cases, they have sent for the parts to construct all our models. Ship Model building is indeed a fascinating pastime.

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Whirling Wheels

(Continued from page 44)

Herrick car first passed beneath the scrutiny of those microscope-eyed boys.

"Say, how about that stunt of floating a storage battery on the line between magnets and distributor?"

"Might be a good idea, try it."

They did, in the laboratory, then on the road. It worked. "Maybe electricity did some good after all, they developed a storage battery. It went out on the cars, and it meant that the additional cost over the old dry cells had to be compensated for elsewhere. Heads together—and a new shop wrinkle that cut machining costs.

"Look here, Meester Herrick. I worked some powerful lag machine tools in my time. In the shipyards. Now, why can't we take a big planer and run a gang o' cylinder blocks through with one set-up?"

MACHINE tool builders entered in, and designed new equipment. Jigs and tools and fixtures—was there ever a more extravagant outfit in the whole world than those automobile fellows? Gosh. They'd buy a machine tool one year and throw it away the next! Anything that won't perdure fast enough, anything that can be bettered—throw it out, scrap it. Great for us, though. Look at our business.

Crank shafts, for instance. At first an ordinary lathe; rough cut, finish cut, polish. Now a big lathe and a hogging cut, then grind. No time for lapping, just create huge grinding machines with stones that whirl at high speed and move back and forth at the same time. Grind 'em to limits. And what limits? Tens of thousands, not thousands! Why, in some places a thousandth of an inch looked as big as the Grand Canyon! Cam shafts. Takes too much time to buy drop forged cam, drill em, and stack em on a shaft, pay the price and get a die with the cam forged right on the shaft—and grind a surface on em. Six-sh chambers, whose job it was to camp at a forge shop or a foundry or a steel mill, and get the orders out. Living right there in that town and sending reports back to the plant.

"Say, you founders got to speed up. We ain't got more'n a week's supply o' castings on hand right now!"

Well, we're going as fast as we can. Capers a gait night and day, we're building more. Can't get any more men."

"All right, ever go through our plant? Why don't you try some o' this progressive stuff?"

"Ha-ha! Put the capers on wheels, huh? Trundle it down the line! You're crazy!"

SO THE Herrick Automobile Company built its own foundry—with molding machines that jolted the sand down to replace the old hand-ramming methods, with a conveyor belt that carried a parade of molds beneath a casting spout and eliminated those sweating, heaving men who staggered along a stationary line and dripped hot iron from hand ladles. Cut, cut, cut! Costs must go down! Prices too.

"Tell me you're after my hide," chuckled big Jim Wendon to Gil Herrick one day in the Patchartram room after the news broke.

"I sure am. And I'll have it nailed on the wall of my office before you get much older."

Afterward, when all the associations that had been formed because of the Seiden affair had decided to get together, they had their words across a common director's table—in the rooms of the National Automobile Chamber of Commerce. And men looked at the steady light in Gil Herrick's eyes—and were thankful that he was not against them.

Motors Incorporated wasn't in such bad shape at first. Jim got a listing for it on the Stock Exchange, and that was no small feat. It was one of the first motor stocks to get a listing. And he kept it moving, too. Some there were who

(Continued on page 168)

Whirling Wheels

(Continued from page 108)

laughed and said they were wash sales; that Jim was buying and selling to himself. But the stock moved, anyway, and held its price, while his four plants, in various parts of the country, hummed as they never had before. One of them he had converted into a gear plant—transmission and differential; one was turning out a high-priced six, with eighteen coats of hand-rubbed varnish and all the trimmings; one was making a four; and the other—the Detroit plant that was the apple of Jim's eye concentrated on the Silent Four. That was his baby. And a good one, too, though there were lots of rumors about it.

At first it was told that the motor couldn't be broken loose in cold weather. The only way to make it go was to put it in gear, put a man on each wheel, and roll it until it loosened up. Jim upset that with a public demonstration. He constructed a gigantic ice box with a glass front and a thermometer prominently displayed, and had a man with a fur coat on go in and up a the motor from time to time.

"Yeah," drawled G. L. "Got a good hunky man, I notice. Doesn't do it himself, either. But say, that ice box idea isn't bad. We'll have one of those, for winter conditions tests in the lab."

JIM did a lot of racing, too. Not himself but with experts hired for the job. He kept three of them traveling the circuits all year, beginning with the Decoration Day affair at Indianapolis and covering the route like a circus. Good advertising, in a way, for his cars won and established records, but frightfully expensive, said G. W., and he knew.

"We'll do our racing in the lab," said he. "And when we've got something we want to race a bit, Carl Fisher will always rent us that brick oval of his at Indianapolis."

And drives against time would be arranged, with a stock car, certified by the A. A. A. contest committee, hitting the bricks for twenty-four hours at a stretch, and the results always broadcast in the newspapers of the country. (They spent money, those automobile men!)

Then the cars began to take on the shape of torpedoes. Roadsters or touring, two-, five-, or seven-passengers, they began to look more like the projectiles they were meant to be, and lose the aspect of illegitimate offspring of carriages; especially so when the tops were let down. That left on y the wood-framed windshield with its brass rods slanting forward, and presented something that looked like a new kind of transportation. The King of Belgium hady was dead—long live the stream line! And G. L. began to make a bid for winter driving as well as summer stuff—closed jobs, with glass everywhere instead of the storm curtains with unglass windows. Twelve-month plant operations instead of eight.

THEN it was that Jim Wenden began to "press." That was a new word, just being taken up by the automobile fraternity. It was a golfing word, and since the players of The Game had made it possible to run out into the country for an hour or two of "cow pasture pool," as they called it, they began to talk the language. And even if you didn't play the new game, being too busy in an experimental room or a president's office, you couldn't help but hear the word. Press: to strive too much for distance, to bat with your club instead of swinging through slowly and surely.

G. L. used that word in '16, four years after his first declaration of war. He had been slipping things over on Jim with a regularity that was disconcerting. In '12 he had made the new cord tires standard equipment; in '13 he had made the windshield a part of the dash and removed those unsightly supporting struts; in '14 he had added electric lighting and starting as standard equip- (Continued on page 110)



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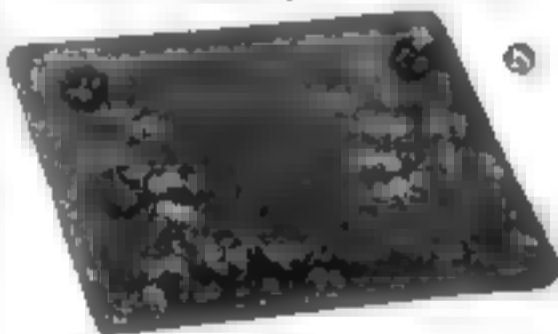
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Whirling Wheels

(Continued from page 109)

ment and changed both radiator and headlight shells from brass to nickel. Always with Jim a year behind. He was too busy in the stock market to spend nights in an experimental room. But now—

Jim announced a lightweight six. Cylinders cast in bloc, transmission a unit with the clutch—that was old—, electric starting and lighting, one-man top—and a motor that turned up 1000 r.p.m. All for ten hundred and sixty dollars, f.o.b.

"And it's going to put one of us out of business, and fail. But it won't be me."

He bought the first model he could get his hands on. That was common practice, there was no way of preventing it. And he lost it down in the experimental room. It looked pretty good, but it was much too light. The bearings were too small; the gears skimped. The differential was a two-spur instead of a three. And the motor was run to destruction in a very short time.

It was an astounding thing, that venture. Coming as it did when a war in Europe was under way, when the industry was already beginning to feel the pressure of scarcity of steel and prices were beginning to soar, it was a desperate move.

"BOYS," said Gil with that light in his eye. "There's a plant we're going to be able to pick up for a song before very long. It won't go to last, you watch. Idea's good, in fact, it's the best idea Jim Wendon ever had. I wonder—bet he's hired a real engineer—and the 'boys' laughed. 'But it's too stumpy'."

And the next time he met Jim he took occasion to tell him so. Adding—"Better pull that model in, Jim, if you don't, I'll get you."

"Thank so," drawled Jim. "That's a good word—stumpy—from you." It put you on the rocks, my boy, I'm stickin'.

Which was exactly what Gil knew he would say. Now, no matter what happened to that car, Jim would ride it through. And he did. It came to be known as the "tin-sixty," that model. Rumors began to float around the lobby of the Pontchartrain. "Took back three thousand rear ends and replaced 'em with three-spur differentials. Had a lot of bearing trouble. They blew up on him. Things like that. Rumors, unsubstantiated, all of them—but there they were—and Motors Incorporated began to waver in the Exchange."

That's costing him millions," said Gil to Andy. "Millions! He's on the run, Andy. And when I find out the right

IT HAD been in the experimental room for three years, that right. It was a timely degree assembly of two four-cylinder blocks, the carburetor and distributor set between them, the cam shaft in the crank case just beneath. At first they had set the connecting rods side by side on the four-throw crank, but that made too much friction. They solved it by making one connecting rod yoked at the crank end, the other one riding inside it, both rods gripped about one long bearing. Lubrication had been the biggest trouble. It had been impossible at first to keep enough oil on the cylinder walls; they ran dry and the pistons scored or scored. Then they got it. They installed force feed lubrication, with oil under pressure from a geared pump, and sprayed the lubricant into those cylinders, both top and bottom, so infallibly that there was never a rub. They went further, they drilled oil holes in the crank shaft and forced a positive feed into the connecting rod and main bearings.

That was a beauty, that right. It had a power flow that felt like the turning on of an electric current. Not one power impulse could be felt, even when they loaded her down to the limit on a tough pull, the cylinders overlapped in power—what a dif-

(Continued on page 111)

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—will start you on the road to success. See Money Making Opportunities on pages 126 to 150.

Whirling Wheels

(Continued from page 117)

science from that old one-lunger? Two power impulses to a cycle, four to every revolution of the crank shaft! It went through the cobblestones, the silent room—a new, sound-proof room had been built in which you could almost hear an eyelid blink—and finished elaborate road tests with a perfect score. It would be a knockout!

And it was—to Jim Wenden as well as the rest of the world. For Jim pressed again. This time he took his favorite motor and changed it. He announced, with a great fanfare of trumpets, that he had a Silent Eight that was a world-beater.

"Turned a darn good four to do it, too," was the way Gil began his next attack on Jim. "You're almost down now, Jim, better pull that eight off the market."

And once again Jim laughed. "Go on, dreamer! smother your pipe! I got you scared now. My engine don't even whisper!"

Maybe not, but Gil had been in the experimental room with one of them; he had not merely taken an engineer's word.

"Too bad, 'ain't it?—as Jim Wenden would say." Gil was grinning at his friends one day, in his office. And what a grin! "Too bad, 'ain't it? That's a good engine, but you can't play your public for suckers, can you, Andy? Well, we'll have that engine pretty soon now."

AND they did. For from that moment Gilbert W. Herrick turned his attention upon the acquisition of Motors Incorporated.

"Now's the time when I want your help," said he to Mr. Marston. "I've got a few millions of my own, but I'll probably need more."

"Going to get him, are you?" The leonine head shook sadly. "Well, it's taken you a long time, hasn't it, my boy? And what are you going to do when you get him?"

"Take those plants and run 'em," said Gil quickly. "Put 'em on their feet—and sit in Jim Wenden's chair."

"In the face of the war?"

"Sure, why not? We're running our own plants, aren't we?"

"And you'll continue to run the others?" the old man asked again.

"Of course."

"That's good. They support a lot of men, you know." Then the old man smiled. "All right, Gilbert, my boy; I'll back you up. With every cent I've got. That first race of yours—"

And so the Herrick Automobile Company became Herrick Motors, and in stockholders' meeting duly assembled voted to absorb the assets and liabilities of Motors Incorporated—at a price. It took a little time, to say nothing of money. Another year had passed before Gil had won full control, but it was done. When one man fails, another one, luckier, harder-working or whatever, profits.

"So long, lil." Jim's voice boomed, his black eyes still had a glint of amusement in them. "I didn't think you had it in you. But it's been fun, ain't it?"

"Sure, Jim. I guess you won't starve to death with your Herrick Motors stock. Give my regards to your father."

HE WATCHED Jim walk away, his shoulders—they were still broad—swagging. And then he went to work.

Work—there was no end to it. With five plants to run and a war on. The days melted into weeks, the weeks into months, the months into years, the Armistice was signed—and he worked harder than ever. A tremendous organization, with thousands of men, and all their families behind them. Ex-soldiers coming home—and the bottom dropping out of the market. Worrying through that somehow, into another great upward rush of business elation—and into another sickening plunge. No roller coaster swoop on a motor parkway ever gave him the

(Continued on page 127)

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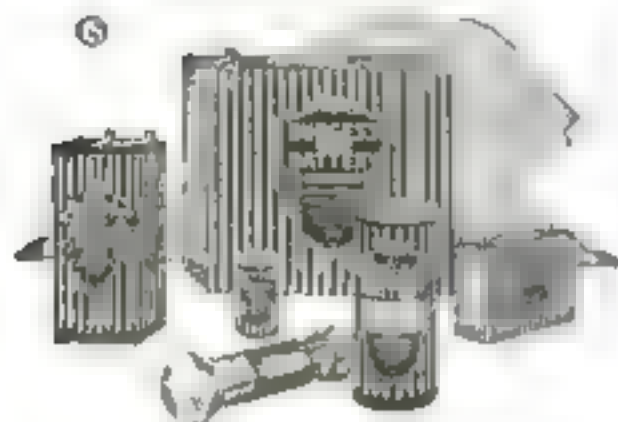
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Whirling Wheels

(Continued from page 111.)

heart-stopping gasp that that one did, no staring into the face of death ever caused so near a panic as those days. The experimental laboratory saw him no more; had not seen him for several years. It went on its way undriven, for there were other things to do. Then it was that he began to appreciate how Jim felt when he began to press. It was a something inside you that makes you swing too hard in spite of yourself. He saw Herrick Motors sagging on the market. Its stock had been increased several times, and while he had never parted with one share of his nor made the slightest effort to get a listing, it had gone on the Exchange. He saw harried men in his offices who asked embarrassing questions about meeting bills; he saw the necessity of slashing inventories to the bone and charging off dollars that were priceless. Why hadn't he anticipated that? Why hadn't he foreseen it?

THEN it was that he recalled a remark of old Oliver H. Marston's, in the bank that day—how long ago had it been?—when he had announced his determination to get Jim. "Harris? My dear boy, he has done nothing but good! Can't you see—"

No, he hadn't been able to see—then. . . . He sat with his feet on his desk for the rest of that afternoon. Then he slapped them to the floor, got into his eight-cylinder roadster, and drove to a certain house on Jefferson Avenue.

"and all those things came back to me," he concluded to an old man. "I needed an enemy, I guess. It was the fight that put me where I am. Why every time Jim Wendon did something to me, fair or not, I bucked in that much harder."

"And I've lived to see it!" the cracked voice of an ancient rejoiced; a trembling hand reached over and patted him on the knee. "I've lived to see it. Gilbert my boy, I've hoped for this day! I could be" said you, long, long ago. Well, here we are, here we are."

Do you know what I'm going to do? asked Gil. The old man shook his head. "I've moved Jim—and I didn't know it—until now. Well, I'm going to put him back in the game without his knowing who did it. He's been planning the last few years—he hasn't been looking. But—why, I haven't had a decent light since we took over his outfit."

And that was arranged. It is much easier to give than take. And even while he was arranging with bankers for the fulfillment of such a plan, he was converting himself into a cold-eyed soldier that walked through the plants of Herrick Motors, and set the players of The Game on fire with his spectacular comeback.

"SOMETHING'S being old G. W.; he's certainly cleaning house."

"Ever see the head of it?" Chopping off heads like a man with a meat ax. They tell me he's got a whole trunkful of empty desks in those plants of his."

"And a whole lot of ex-managers and ex-superintendents back on the jobs they had before the war?"

"And boy, ain't he moving his bones! Hot dog!" He acts like old Jim Wendon was after him again."

Then one day—the boys in the experimental room will never forget it—he walked briskly into their midst.

"What's going on?" He actually rubbed his hands."

"Well, we got a supercharger under test. They seemed to be quite a stunt on airplane motors, and it sure looks like we're going to have to put 'em on cars one of these days. The way they're cutting down on piston displacement, we're going to have to use needles for pistons before we're through."

The boys laughed! (Continued on page 113.)

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Popular Science Monthly

150 Fourth Avenue, New York

Whirling Wheels

(Continued from page 110)

"Are you doing anything with balloon tires?"

"Sure, got 'em all whipped. And a new steering gear for 'em, too. Had to pass up the old worm gear. Been trying a new cam-and-lever that looks pretty good."

"And say—" the boys had gathered around and another excited voice burst in. "Come over here and take a look at the new seven-bearing crank we got on the six! Takes all the whip out of the shaft, and lighter, too."

"Looks pretty good. How about four-wheel brakes? Tried 'em?" Scappy, interested!

"Sure, two kinds, hydraulic and mechanical. And a new carburetor. Gosh! There's always something to do with carburetion. Here's an idea for a new manifold, and we've got a brand-new venturi tube coming along—"

"YES, that's a big problem. Gas isn't what it used to be—not with high compression engines. The boss' eyes were taking on the dreamer's look that always meant that something was coming of which they had never dreamed. Hot stuff! "Ever think of this? Boiling down a Diesel engine? Now there's something. Hot tubes for ignition, big cylinders, enormous pistons—that's the way gas engines started thirty years ago. Let's see what we can do on that."

The boys exchanged delighted glances, and G. W. started in again.

"Well, here's what I want next. A new six, in line for the '28 model, can you do it? And a straight eight. Eight is line. That'll take a little time. Then we've got to get a light, short-wheelbase, low-center-of-gravity car with a high speed motor. Something like that old tin-can of Jim's, only better; much better. It's got to be a six, we're going to wash out the four this year."

"Then I want one of you to get ready to work with me on that Diesel idea. If we can get one hauled down to motor size, and use fuel oil instead of gas—"

While down at the D.A.C., the magnificent new meeting place for the players of The Game, every tongue was busy speculating upon an event that almost rocked the granite walls of that splendid clubhouse.

BIG Jim Wenden, twinkling of eye, big-voiced, grinning, had met G. W., and they had done something that no man had ever seen them do before. Jim had come striding into the club that day and ran smack into G. W. right in the middle of the great rug that softened the marble floor of the main hall. Dressed a little handsomely, as usual, and with some gray over his temples, he had gazed down at a dapper, slender G. W. with the same quizzical look that he always had for him.

"Well, well! Here we are again! Look out for me, Gil, I'm going after you again!"

"You don't say so? What are you going to use for money?"

"Cash, my boy, cash! Got some big ten behind me now. An I'm going to give you a real run for your money!"

G. W. frowned. "That so? Thought you had enough."

"Me? Not so you'd notice it! Not with something new for a motor. Wait till it comes out. I'm going to run those cars of yours off the streets! Hammer and tongs, Gil, fair an' square. An the devil take the hindmost!"

"That sounds reasonable, Jim. Suppose we shake hands on that."

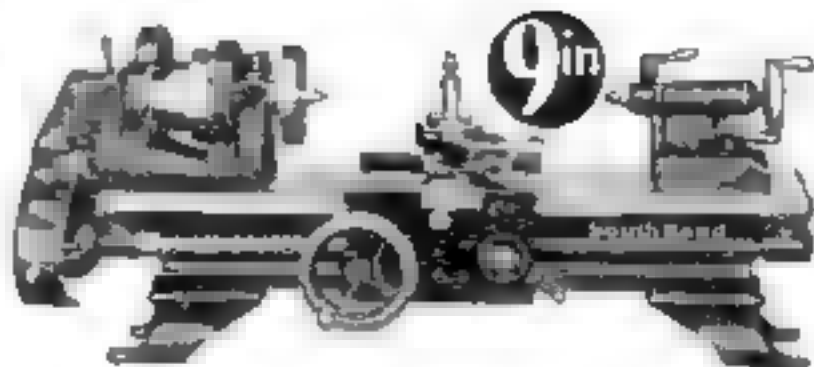
"Who, me? Shake hands with you?" Big Jim Wenden snorted. "Aw, I might hurt you."

"I'll take a chance," with a queer, twisted smile. "Once."

And G. W. actually shook hands with big Jim Wenden.

THE END

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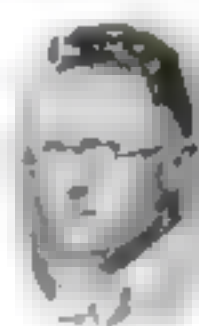
Marvels of Progress in 1927

(Continued from page 27.)

ASTRONOMY

DONALD H. MENZEL, PH. D.

Astronomer, Lick Observatory, Mt. Hamilton, Calif.



THE astronomical year reported many important events, discoveries and advances. At the present writing seven comets had been found, four of them being new. Only one, Pons-Winnecke by name, came near enough to the earth to be visible to the naked eye.

The eclipse of the sun, June 20, total for England and Norway, was, unfortunately, obscured in many regions by clouds. The total lunar eclipse of June 15 was studied at various observatories of the Pacific coast. Probably the most important result was the finding by Nicholson and Pettit that the temperature of the moon's surface fell rapidly from a value a few degrees below boiling water almost to that of liquid air.

Trumpler's measures of Mars have given revised values of this planet's diameter. Wright's color photographs of Venus, Mars, Jupiter, and Saturn reveal much about their surface and atmosphere and lead to important conclusions regarding their nature and constitution. Coblentz, Lampland, and Menzel find their earlier estimates of the Martian temperature confirmed and that the warmer portions of the planet are above freezing.

Hubble's researches upon the number and distribution of the extra-galactic nebulae have led to interesting ideas regarding the structure and extent of the visible universe.

The recent establishment of large telescopes in South Africa, by Harvard, Yale, and Michigan promises that we shall soon know much more about the southern stars.

METALLURGY

ROBERT J. MCKAY, B.S.

Superintendent, Technical Service, International Nickel Company



THE outstanding metallurgical advances of 1927 have been useful applications of research of former years.

Aluminum alloys, virtually as light as aluminum and almost as strong as steel, were perfected, making all-metal airplanes practical.

New alloys of iron and steel improve the

resistance to rust and in some cases the strength and ease of working.

Laboratory research has proved that corrosion and failure under repeated stress inaccurately called crystallization depend on each other. The X-ray has become a useful tool in exploring the internal makeup of metals.

Scientific control has improved in electroplating processes, making nickel and other protective plating more impenetrable. An outstanding case is the lasting and beautiful chromium finish on nickel plate now becoming common on automobile radiators and plumbing fixtures.

New alloys several hundred times more responsive to magnetic influence than the soft irons formerly used increase the speed of wire messages enormously.

Steel building and airplane structures joined entirely by welding have become practical.

In the copper industry study of single

crystals and pure metal points improved electrical conductance.

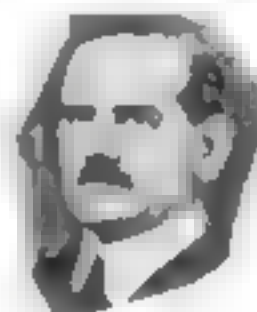
Alloying nickel with cast iron improved exact machining of automobile cylinders, and produced a much improved steel mill mill.

These advances point to future building of lighter, stronger, more efficient machinery of all types.

AUTOMOTIVE ENGINEERING

ALFRED REEVES

General Manager, National Automobile Chamber of Commerce



RECENT advances in the engineering of motor vehicles have been largely in economical performance. Better fuel economy is being realized through the building of engines with smaller combustion chambers, giving higher compression of the combustible mixture, made possible by the now general availability of 'antiknock' gasoline.

The now general application of gasoline strainers and air cleaners has contributed to freedom from combustion troubles and helped to better utilize the power in the fuel.

Similarly oil filters and oil purifying systems have reduced the waste of lubricating oil which heretofore has been discarded because of its pollution.

Increasing use of rubber cushioning devices in engine mountings, spring shackles, etc., by minimizing shocks and reducing vibration, are making cars ride easier and last longer.

Reduction of weight by scientific design and the use of alloys of greater strength for given dimensions is adding to the gasoline mileage by reducing the dead load carried, and this with lowered centers of gravity is making higher speeds possible with safety and comfort.

CHEMISTRY

ARTHUR D. LITTLE

Nobel Engineering Chemical and Inventor



AMONG the year's important contributions in chemical research are

The production from water gas of methanol and a whole series of gaseous, liquid, and solid hydrocarbons from methane to paraffin.

The active work toward the synthesis of rubber, tying this in with the chemistry of petroleum.

The discovery that it is possible to electroplate rubber from its emulsion.

The recent adaptation of solidified carbon dioxide gas to such contracted purposes as refrigeration and fire fighting.

The development of anti-oxidants by means of which the life of rubber tires and other articles is greatly prolonged.

The utilization of gaseous ethylene and propylene in anesthesia in place of ether and the use of ethylene for ripening fruits.

The rapid expansion of the manufacture of artificial silk from cellulose acetate and the utilization of cellulose acetate in powdered form as a molding plastic.

conclusion is supported by recent experiments of Davison and Germer, who have discovered that the distribution of electrons reflected from a nickel crystal bears a striking relationship to X-ray diffraction.

In the study of the structure of atoms, attention heretofore has been directed largely to the electrons (planets) surrounding the central nucleus sun, the latter being considered as a closely packed mass of protons and electrons. But Sir Ernest Rutherford now tells us that the central nucleus of a radioactive element is in turn made up of a planetary system, the satellites of which consist in part of distorted helium atoms in quantized orbits.

RADIO

J. KELLY JOHNSON, E. E.

Radio Engineer, Columbia University



FROM the standpoint of the broadcast listener, the year's most important event in radio was the standardization of frequency and the scientific re-allocation of wave lengths by the Federal Government, indicating the beginning of a much more stable era in the art.

Technical developments in broadcast receivers have been largely

in the direction of simplified operation and upkeep by the widespread adoption of single dual control and automatic power supply from alternating current lines.

The incorporation of high quality electric phonograph units in the better type of receiver cabinets indicates definitely a growing demand for higher quality of musical entertainment. This has been fostered by a decided improvement in the tonal quality of the better grade receivers and broadcast programs.

More important advances in the technical field have been the establishment of reliable, high speed, short wave, round-the-world service and improvement of transoceanic speed and reliability of service.

GEOGRAPHY

G. D. HUBBARD, M. S., PH. D.

Professor of Geology and Geography, Oberlin College



GEOGRAPHIC advances in 1927 lie mainly in three fields: exploration, conservation and construction. In exploration the flights across the Atlantic to study more of the meteorologic conditions, and to learn air routes and test air conditions, are the most spectacular.

In conservation, the boundaries and transportation of disease have been studied. The great pilgrimage to Mecca was safeguarded from carrying cholera and plague by quarantines and other sanitary measures, sponsored by the League of Nations.

In economic and engineering geography, the Mississippi floods brought needed reconstructive and preventive programs. Recognition of soils as a factor in geographic interpretation has taken great forward steps. British manufacturers are planning, by the aid of the warm, dry climate, to recover potassium chloride and other salts from the Dead Sea.

Three Captains

(Continued from page 32)

red below, murky yellow above. Soot streaked her upperworkings. Broken glass disfigured her squat pilot house. Upon her dirty decks she carried an ugly cargo of scrap iron, outworn machinery, junk. Only smoke from her short, warped funnel spread like an unclean blanket over her sides.

"Faith, and what's that thing afloat?" Captain Michael grunted. "It's indecent, such a creature on clean water."

A man in untidy clothes appeared on her dingy bridge as she came alongside. His only face started Michael. It was young Wil Harrison; not so young any more, in his thirties at least. But he looked like his mother still.

"That's the lad from Gary," Dunley explained at McCarty's elbow. "Beachcomber. They say he's making money."

"Harrison's his name?" McCarty asked. "Aye. Carries junk, fish, any old thing. Grand Haven to Chicago. Anywhere. Two in his crew, engineer and a deck hand."

McCarty made out her name in dingy white across the rail.

"Gutrich," he read, "of Michigan City. Should be a law against such disgrace," he commented.

THE Wells Street bridge tender rang his bell. The great span began to lift and the red nose of a freighter poked out of the north branch of the river, where oil storage tanks line the bank.

Michael recognized this vessel. It was the *Salem*, his brother's ship. She moved with ponderous ease. Her bow seemed to turn up disdainfully as she came abreast the disreputable *Gutrich*. The "trust" and the tramp passed without speaking. With untroubled lights the *Salem* swung lakeward and the Clark Street bell rang for her passing.

Captain Michael first thought of retiring to his pilot house when his brother's craft came into sight, pride prevented it. He leaned at bay against the rail, appraising Captain Joe's command. Joe stood on the bridge, eyes turned to the channel ahead, hand on the signal control, oblivious to all the fire tugs in the world. Mike realized that his brother was grayer than when he saw him last. He wore a blue cap with patent leather visor, and a blue serge suit went as Mike's own. He was entirely at ease on his high bridge. There was confidence in his pose, his sharp profile bore a look of quiet security.

THE *Salem* lay low in the water, indicating that her tanks were full. She was bound down the Lakes, to Detroit or Cleveland, or the Welland Canal or the St. Lawrence and Canadian ports. Her stern swung sharply and she pointed her bow toward open water.

"Neat vessel," said Dunley.

"Humph!" responded his captain.

Michael climbed sulkily the short ladder to the river bank, where an old brick bunking housed the alarm instruments and the bunk room. He sat down gloomily at the desk in his own quarters. Heisen's boy was a beachcomber, eh? Poor business for a decent woman's son, if anybody were to ask him. At least Joe looked like a captain.

"Blast him!" he grumbled. "I've a pity for them as sails under him." He scowled at theinky blotter. "And her lad owns the *Gutrich*, does he? I'll remember that name. Blast 'em both!"

He kicked back his chair just at six o'clock and crossed to the window. He observed that the air was cooling. It would be a pleasant evening for late August. Suddenly the noise in the squad room ceased.

The tiny steel teeth of the poker alarm instrument were biting out a message. Three dots. Then seven. (Continued on page 116)

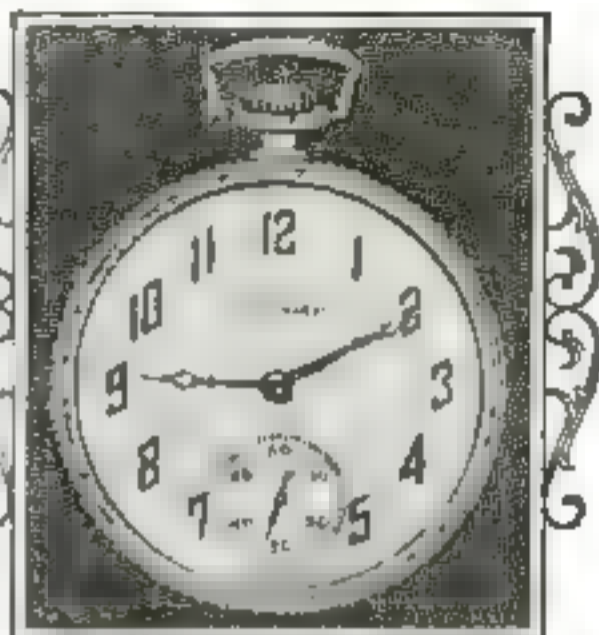
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Three Captains

(Continued from page 116)

"Smell it?" asked the pilot.

Captain Michael nodded. He had a nose for smoke, better than the pilot's. He'd smelled it for five minutes. He stepped out to the bridge and called Donley. The wind struck him sharply.

"Four lines," ordered the captain, "couple o' lengths apiece. And a boat line, one length on it. Set up tripod on deck. Put Swensen on forward gun, Burmeister on other. Cork and Cohen take boat lines. Set tripods fast to deck. That leaves four men on other lines. One apiece."

"Me?" asked the senior pipeman.

"You keep an eye on 'em. Put water where water's needed. Stir out that engineer. Tell him what we got to have."

"It's a bad 'un," said Donley.

He looked forward, hanging to the bridge ladder. Dark lay like fog on the lake. Straight ahead, crimson, orange, amber, carmine and scarlet, an angry splotch of fire thrust out of the black water of the lake. It was only three miles off.

"You?" Donley asked suddenly. "Where'll you be?"

"Me?" answered Mike. "I'll go aboard her."

"Aboard? We're running right up to that blasted thing?"

Captain Michael did not trouble to reply.

"IF THEY'S a foothold aboard, I'll call for the ones. The four. Send 'em over and I'll place 'em. Keep the boat hose on its tripod. Give it to 'er with the guns. Tell the engineer we got to have water. Twenty thousand a minute. When we run alongside, be ready to make fast."

"Y' got a poor one," the senior pipeman replied, and swung down the ladder. "Out, ye lousy ape!" he bellowed. "It's a job of work!"

"Run alongside," Mike commanded the pilot.

"Can't, sir."

"Can't? Give me the wheel!"

"I'll try," the pilot agreed morrowly. "try it myself."

The sharp odor of burning oil stunted across the fire tug. Stray gusts of heat flung a half mile, plastered against Mike's hard face.

"Are you hackin' up?" he cried over his shoulder. "Or is maybe the engineer sewin on his buttons? Ain't they any decent speed left in her?"

"I'll slide around to windward. Looka' Men, fore and aft! Fire 'madship!"

"It's coal oil," Captain Michael answered. "For ard, on the off side. Looks easiest there."

"Not'n's easy," the pilot contradicted.

FIGURES of sailors were outlined momentarily against the burning tanker's pilot house. Other figures, far aft, were laboring on the roof of the cabin about the life raft. On the deck of the tug, Pipeman Swensen climbed the four iron steps to the forward gun. He tipped its jawly muzzle up and down, twisted it experimentally, dropped his hand to the trigger.

Captain Michael observed him, then stared ahead, scowling. He just had recognized this vessel. He might have known it. She had just passed him in the river, hadn't she? He scowled again, and put up his hand uncertainly and wiped his dry mouth.

"It's her!" he grunted.

"Know her?" the pilot asked.

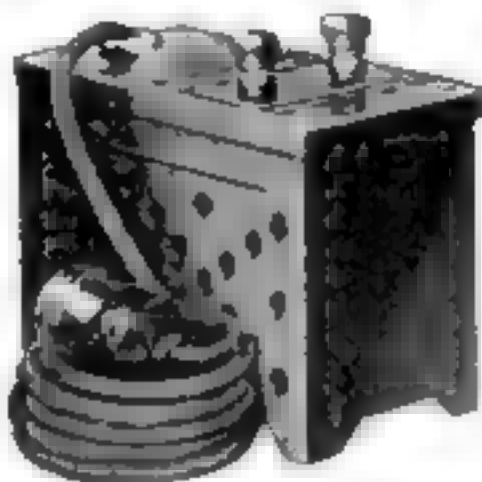
"The Salem," Captain Michael answered, and shut his lips tight.

Joe McCarty's tanker was ablaze just aft of amidship, over a hundred feet of her length, on port and starboard sides. She was rolling gracelessly in the rising seas. Flaming oil flowed over her.

(Continued on page 118)

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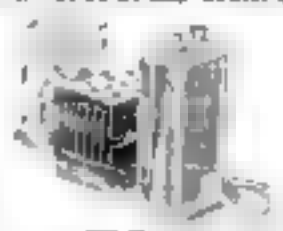
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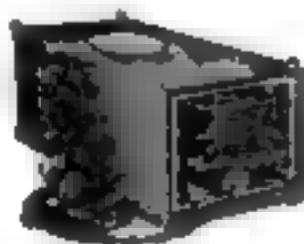


To attach the KUPROX Trickle to your battery is to have a real trouble-proof power unit.

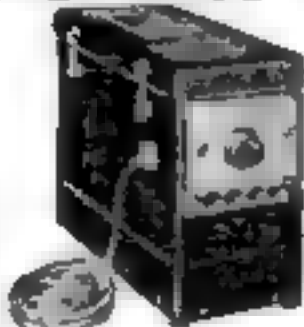
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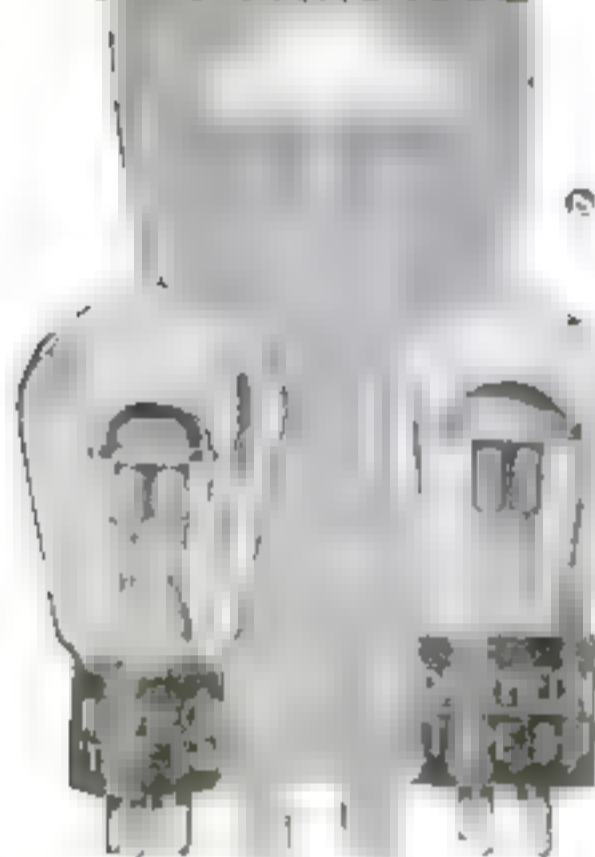
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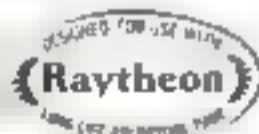


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Raytheon
LONG LIFE RECTIFYING TUBE

Three Captains

(Continued from page 117)

deck and spurted far out upon the dark water. Alongside, commanded Captain Michael, "alongside to windward. And draw up close forward. Best now down."

Immense bursts of heat erupted from the tanker and thrashed across the bridge of engine 37. Captain Michael turned up the rubber collar of his slicker and ducked his head stubbornly into it. The heat found its way past his leather helmet, but persistently at his ears. The tug was swinging in a circle. It passed broadside to the burning vessel.

Too slow, commanded Captain Michael. He squared his shoulders. What difference whose boat this was? He felt satisfaction. He'd show Joe Mcarty now! Joe was needing help after all these years, eh? Needing help from the fire department. Well, he'd show him now who was the better man. He descended the short ladder to the main deck. Donley ran toward him.

Turn loose? he shouted.

CAPTAIN MICHAEL nodded. He saw that his crew already had dropped behind the scanty protection that the sides gave against heat. Only the brass tips of four needles thrust over the edge. On their exposed turrets Swensen and Burmeister shirked their faces.

Captain Michael flung a leg over the rail, ready to leap. The bow of the tanker lay only seventy-five feet ahead. Flaming on, spurted overboard. The blaze like a huge torch cut water and wood and steel into grotesque illumination. He saw half a dozen men crowing into the peak, impatient for rescue.

Behind him, on the deck of his tug, there sounded a mighty rumble and from the muzzle of Swensen's cannon there shot a gray white column of water thick as an elephant's leg. Straight, defying gravity with its very speed, it buried its tons of wet ammunition at the foe. The red-hot steel plates of the Salem crackled as the water hit them. Black smoke, coiling upward, wrapped itself about the tug. The water pumpled through it. Flame reappeared.

The heat lay only thirty feet off now. Captain Michael, one leg still overboard, leaned against the heat. Like a rock wall it was.

Ten feet. The high side of the vessel shivered him somewhat. Smoke in waves rolled down upon him. He choked. Then, from the rail of the Salem high above, a man leaped unexpectedly to the deck of the fire tug.

He fell. A stout heusen line wriggled down the side. Captain Michael caught it, made it fast. The pilot backed water.

A second sailor slid the line. His face was blood.

Put him over the water, he cried. "He's burnt."

A MAN'S body appeared at the upper rail. It hung limply for a second, hands from above supporting it. Hazardously the immobile shape dangled with ten fathoms of cold water under it and the sides of the vessels pulling apart. The captain reached upward and gripped the man's ankles. He felt ankle weight and fell with the body atop him.

"Tend him!" he yelled to the bloody sailor. Two men slid the rope. Then another.

"I'm second officer, sir!" the last one shouted. "Best get away. Whole thing's like to go any minute. All down from there."

"Where's the rest?"

"Aft. Engine and fire room crew. Getting out the raft. Four men killed. Third officer and three deck hands. Brown over."

"Where's your captain?"

Aft on the tanker the life raft thrashed into the water. Men slid its lines. It put off.

"I say, where's..." (Continued on page 119)

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Three Captains

(Continued from page 118)

your captain?" Michael McCarty cried again.

"Got away. Jumped!"

"Left you on? Jumped? Left you aboard?"

"You said it!"

A long second Michael McCarty stared angrily at him. Then for the first time in thirty years he spoke in defense of his brother. "That's a lie!" he shouted huskily, and hand over hand he went up the rope and over the side.

Free Silver Donkey ran forward, bellowing. Three men with muskets charged at his heels. The forward gun still washed at the fire. The other out of range, had ceased to throw water. The boat rose, on its tripod, flung its two thousand gallons a minute in a high arc.

"The old man's over. Free Silver Donkey cried.

CAPTAIN MICHAEL McCARTY, alone in the forward deck of his brother's vessel, dropped behind the protection of a ventilator then dashed once more into the heat. His hands blistered through his gloves as he gripped the iron ladder to the bridge. Steam from the pilot house windows rattled down upon him. He crawled around the bridge. No one here. No one in the pilot house. No one in the chart room. No one in the officers' quarters—he tried the three doors, explored blindly.

Captain jumped before the crew was off? Joe, a McCarty?

"It's a lie," he muttered.

He crawled out to the torture of the bridge and sat in the deck. Something seemed wrong. He looked about uncertainly. Then he saw. His own boat was drifting. The line that held her to the *Salem* was broken. She lay fifty yards off. Free, but still pouring water. Seven hearty streams played on the fire. Twenty thousand gallons a minute. The tanker hissed, ignoring them.

"Line hauled, eh?"

Captain Michael straightened up, considering his predicament. He was cut off, all right. And still no sign of Joe. Best get back to his own boat. But how?

"All up to Donkey," he muttered. "Leave it to him. If he's a decent fireman."

He stopped, tried to run. With a roar that resounded down the lake, a new tank exploded. Iron plates ripped off. A sawing geyser erupted into the windy sky. A thousand gallons of oil burst into the air, spattered Engine 37 with fire, burned in wide rolling patches on the surface of the water.

Engine 37, one deck house ablaze, pulled back her streams from the vessel she had come to save and turned them upon herself.

MICHAEL McCARTY lay still an agonizing moment, far forward in the peak where the force of the blast had flung him. Then he rolled over and over, smothering fire from his slicker.

"All by all the holy hydrants where's Joe at now?" he demanded.

He crawled back toward the bridge. A black gaping doorway below the pilot house spat out smoke like a chimney. He reached over the wash board. Breathless in there. A stair companionway to the crew's quarters?

"Hey!" he shouted. "Hey, Joe!"

He choked. What good was shouting? A throaty, savage chorus rose from the four blazing tanks. He felt his head sagging. Again he crawled forward, into the scant protection of the observation. Better here.

He rubbed his smarting eyes. Doubt tempted him for the first time. Perhaps that officer was right with his filthy accusation. Joe might have left his crew.

"It's a lie," he muttered.

But where was his own boat?

He saw two boats.

(Continued on page 120)

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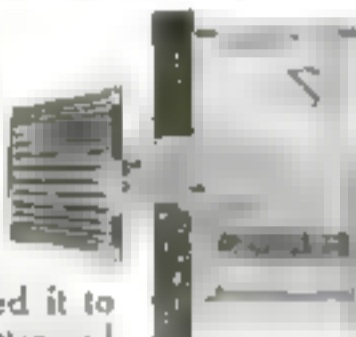
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The perfect filament control. Easy installed in place of rheostats now in service. Gives noiseless, stepless filament control for all tubes. Use Bradleystate on your next set.



Three Captains

(Continued from page 117)

out there in smoke. His own and another, a small, impudent craft with a pointed spread eagle on her pilot house at the side of her stack a tall ship. The Great Lakes Towing Corporation, that meant. A tug she had put two small hose lines into action. And Engine 37 had crowded closer again.

She was still afloat. Her light lines still played on her own upper workings, but the force of two guns and the great heat from the flung once more at the Salem, Captain Michael crawled back toward the fire.

"Joe!" he shouted huskily.

The black doorway to the crew's quarters still spouted smoke. His hand pawed over the wash board.

"Joe!"

Plugging the bulkhead, he let his feet down the steep ladder. Cooler here. Cooler, out and out.

"Hey, Joe! What you, where you at?"

He climbed down three steps. Five. Nine. He felt cold decking under foot at last. And something missing. Something that clung at his ankle. He reached over. A trap, all right.

THAT floor pitched, and he sprawled on his face. The boards were hot under his seasoned skin. Smoke stuffed his nostrils, made his head dance. He crawled up. His knees. A hoarse voice rose on a spike through the tumult of fire.

"Need a hand . . . leg's broke."

Captain Michael heard him unemotionally. This was Joe, asking for help. He gripped his brother's hand and hauled. Cawked to his shankles. A spasm of coughing overcame him. Have to get out of this. Get out quick.

He felt for the ladder. Joe had put on weight three years. Mike's boot fumbled at the bottom step . . . up.

A breath of cooler air struck his face, then an immense pelting heat. He tumbled out through the companionway.

He was dragging Joe to the open deck when another tank tipped off its lip. Three new stars arched about them, hurled them forward into the peak. Captain Mike's head brought up violently this time against a hot steel plate. Captain Joe dropped across him. The blaze met lake and sky in a domination poured its light down on Mike's sooty face.

"You! Captain Joe!" cried. "You, Mike! Hang on, what you want here. Get out. It's too hot out here."

Mike moaned. Captain Joe stared uncomprehendingly at him. His brother lay on the deck of the Salem, knocked out. And his own leg useless. Well.

"Come on, Mike, get a move!" he ordered.

WITH difficulty and a weak oath, Joe dragged his weight from Mike's limp body. He could see three craft out on the lurid water. Engine 37. Mike's command, was blazing vigorously. That to port was a Great Lakes tug after bow to stern. Three ship lengths off a white speck in the glare a tiny boat from the United States coast guard struggled unpotently, under oars, to free itself from the menace of a burning lake.

"Guess we're done for," Joe said, "guess both McCartys is done for."

He moved painfully, tried to sit up. He had heard a new sound through the howl of flame. Another boat approached, shrieking its whistle. An ugly, cumbersome craft. A moment it deliberated at the edge of the blazing patch of oil, then came on. It bore down recklessly upon the tanker.

Mike stirred. His lips moved. "It's a lie!" he muttered.

"Sure," Joe answered, "all this is lies. Things like this don't happen."

His disintegrator.

(Continued on page 121)

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Three Captains

(Continued from page 120)

ing vessel rolled tipily, listed first to starboard, stood upright for a perilous second, then leaped far to port. The deck slanted like a roof.

"Whoever's going to try helping next'll have to do it fast," Joe whispered.

The small black vessel thumped into the "trust's" high side. A man hesitated a moment at its rail, then climbed upward to the deck of the *Salem*. He wore a shapeless blue cap, his clothes were grimy. He pawed at Joe's coat. Joe shook him off.

"Other one first," he said.

A long time the fellow spent, reaching Michael. Joe closed his eyes. The heat was unbearable. He was feeling mighty groggy. He tried to push the man away when he did come back, resisted, to no consequence. He felt himself picked up roughly and swung overboard, heard the man cry "Reverend!"

HE WAS conscious that this boat, too, was afloat. Awkwardly, with something like a waddle, she tumbled across the blazing surface of the lake. Her wooden sides, that seemed soaked with tar, made rich fuel for a hungry fire. Joe squeezed shut his eyes, opened them again.

He saw the Great Lakes Corporation tug standing by at two hundred yards, her crew still battling flames upon her own deck. Only Engine #7 was turning her nose toward the new fire. She pointed boat line, water guns and four brass nozzles at the disreputable little craft on which the brothers McCarty lay. The first blow of the forward cannon ripped holes through the rotted upper workings.

There was a commotion below. An engineer leaped up to the deck, crying

"Water over the grates!"

"Got to close close," the grimy captain yelled to Donley on Engine #7, "need a line guess we're sinking."

The fire tug pulled alongside.

Captain Michael McCarty lay on the watered deck of his own fire tug when consciousness came back to him. The great long-armed sailor Joe was stretched out beside him. Mike grunted. Joe was all right. Let him stay where he was. It wasn't Joe interested him most right now.

That fellow standing down in the stern looked like young Harrison the beachcomber, if he knew his own eyes. What was he doing here on Engine #7? Watching a boat sink, apparently. The *Ostrich*, eh? Must be. Well, good riddance.

"That's the man as hauled us both off, Joe volunteered.

"Him?"

"Looka!" cried the pilot.

THE blazing *Salem* lay upon her side, some distance off. Her bow pitched upward just at the pilot's cry, her fantail stern dipped under. She swung in an arc and the bow lifted higher. With sound ceremony she slid down by the stern. More oil poured out upon the distraught water and burned fitfully.

The Great Lakes tug circled about beyond range. Near by, with a life raft in tow, floated the persistent small boat of the river coast guard crew.

"Aye, it's her boy" Mike was telling Joe ten minutes later.

"A good lad," said Joe.

"Aye, seems like it," Mike responded.

Donley halted before them.

"That man Harrison feels bad, lost'n his boat."

"A poor thing to feel bad over," Michael answered. "Clean water's a lot better off 'bout a disgrace like that. But he's a right good man. I'll make a fireman out of him."

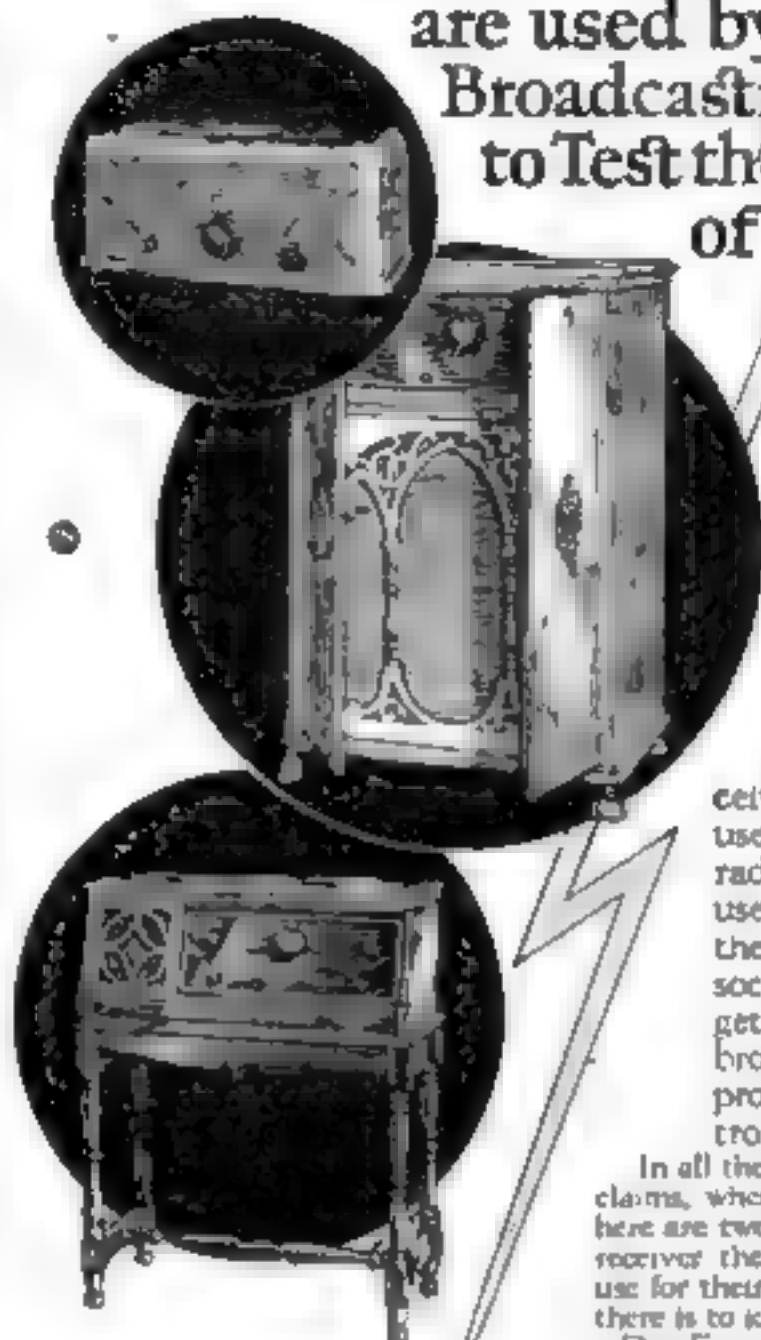
"A what?" growled his brother.

"A fireman."

(Continued on page 122)

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Battleships on Wheels

(Continued from page 115)

gun car was lifted from the trucks about four inches. By screw jacks in the bedplate casting of the foundation, it was brought up until it engaged with the similar casting of the gun car, and the load of the car rested upon it. The girders were then moved to either side of the center line of the track, leaving a clear space for the gun to recoil. Screw jacks were placed under the heels of the girders to prevent side sway and the 100-ton jacks removed, allowing the whole weight of the gun car to rest on the foundation and rear jacks.

Now we could fire at our maximum elevation, forty-three degrees, and our maximum range, 44,000 yards, from any place in France where there was a railroad track, twenty hours after receiving our orders.

WITHOUT ever seeing a German long-range gun we had worked out a carriage similar to theirs, but better. For before their guns could fire, they had to be dismantled from railroad carriages and mounted upon turntable arrangements that took two weeks to build. We could follow behind an advancing army, firing if necessary direct from the tracks up to 25,000 yards without waiting to dig the pit foundation.

Besides five gun cars our fleet would need:
Six consolidation locomotives.
Ten ammunition cars.
Fifteen berthing cars for the crews to sleep in.
Six construction cars.
Five each: kitchen cars, headquarters cars, fuel cars, workshop cars, construction cars with cranes, and sand and log cars carrying pit foundation material.

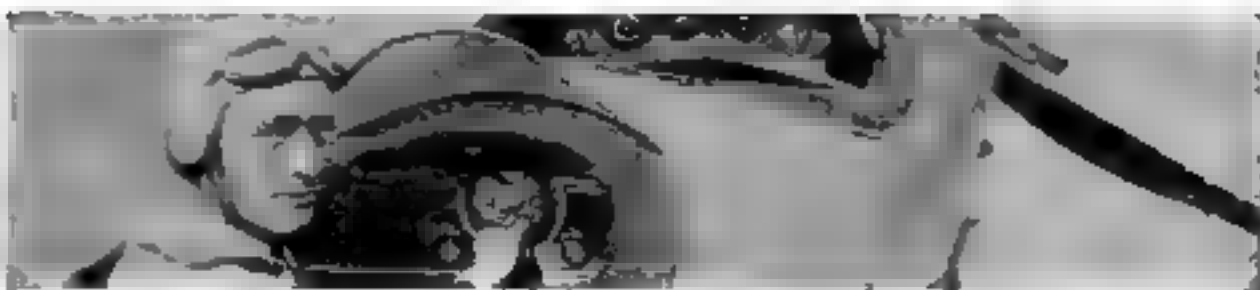
For the central command the executive officer's car would be the land fleet's flagship. That was where I wanted to be. I had asked for the job and on February 19, 1918, Admiral Benson ordered me to "confer with the Bureau of Navigation and Ordnance with regard to the assembling of the personnel and material for purposes of training previous to departure from this country." The "previous to departure from this country" part didn't trouble me a bit. I was going to stick to those battleships on wheels like a harness until we made port on the Western Front.

MY FIRST job was supposedly to ship crews; the real job was to pick crews. We did our best to keep the expedition secret, but the news spread that we were taking the most powerful guns to the hottest sectors, and 20,000 officers and men begged to go—and we could take only thirty officers and 300 men!

Not many of those could be regular Navy men, for the Navy had other jobs and too few "old salts" to go around. I picked most of my force from the Naval Reserve, men who had little or no experience with guns, but were intelligent and enthusiastic and eager for a crack at the Boche. I had been supervising the Navy target ranges where these men were being taught to shoot revolvers, rifles and machine guns, and the idea came to me: "A man who is good with a small arm will be better with a big gun than a man who has never fired at all." So we started to comb the target ranges.

We got the pick of them. Quite a few were college men, especially from the University of Michigan naval training school. Some of the best weren't college men, but crackerjack machinists, electricians, engineers, firemen, carpenters, radio men and general good Yankee handy men, handy with their hands and heads. Long before our own guns were ready, we had these men loading and firing and tinkering with any big guns they could lay hands on.

Then we struck our first bump. The bids all named remote dates of delivery. Most big railroad construction shops were working to capacity. Representatives of leading companies were present when the bids were opened. Then the doors were locked. (Continued on page 124)



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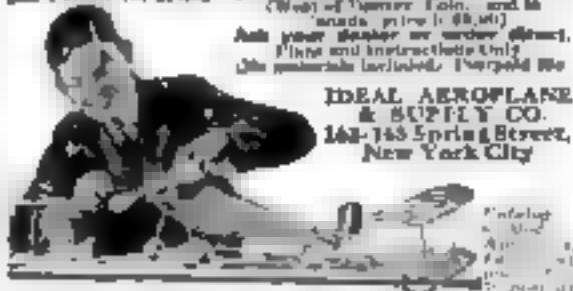


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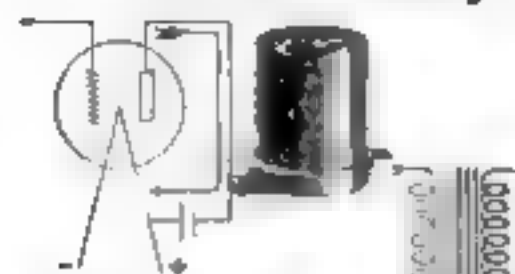


Diagram shows Hammarlund R. F. Choke in the detector plate circuit of a radio receiver. It is a position that blocks radio frequency currents from the audio transformer, returning them to the filament circuit through a .001 microfarad condenser as indicated by arrow. The audio-frequency currents are blocked by the condenser but pass freely through the choke to the audio transformer.

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IN YOUR radio receiver are two kinds of currents—radio, or high-frequency and audio, or low-frequency. Both are necessary. But they must be kept in proper channels if you would enjoy stable reception and good tone quality.

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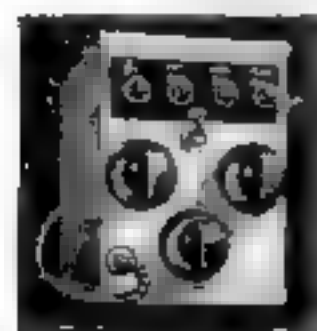
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Battleships on Wheels

(Continued from page 123)

and they were told the German drive, due in March, might capture the Channel ports. They saw the light and asked for another chance.

At that second meeting were some of the biggest men in the business, including Samuel M. Vauclain, chairman of the Munitions Committee of the War Industries Board and vice president of the Baldwin Locomotive Works. Everyone else wanted to put the thing over, but couldn't see how. He jumped up and said: "If the American Bridge Company will help us, the Baldwin Locomotive Works will build the gun cars in a hundred and twenty days."

That set fire to Mr. J. M. Hanson, president of the Standard Steel Car Company.

"If you can do that," he cried, "we can deliver all the auxiliary cars at the same time."

Then and there the bids were accepted. The Baldwin people took on the locomotives and gun cars, and the Standard the seventy-two auxiliary cars. Baldwin's promised to deliver the first of them May 15, the last about June 15. They finished the first mount April 25 and the last May 25. The Standard people beat their schedule and delivered the auxiliary cars by June 1, though a fire and cyclone hit their shops at Hammond, Ind.

We helped every way we could, and assigned some of our newly chosen crews to the Baldwin and Standard shops. We got skilled mechanics from the Great Lakes Naval Training Station.

Then we struck another bump. We had the mounts and the trains, and the guns, but would they work? To find out we would have to fire the blame thing, they said. For a big enough range we had to borrow Sandy Hook from the Army, but a storm had washed out the track connecting the proving ground with the railroad and it took every god and dough-bu for miles to lay new track heavy enough.

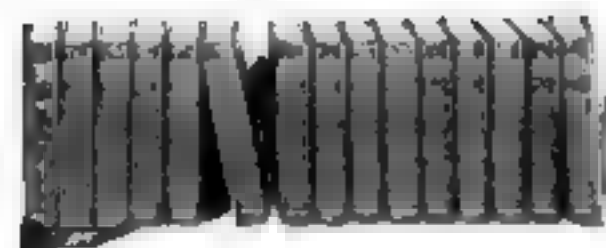
FROM the Baldwin plant at Edgelyton to Sandy Hook we had a special train. We craned our necks to watch for predicted trouble but the train drew the big gun as smoothly as a roller coaster. That was the heaviest rolling stock ever transported over a railway. The mount weighed over 250 tons, the load between the rails and wheels of each axle on the rear truck was 30,030 pounds, and on the front truck the reaction on each axle was 30,350 pounds. That was our famous "axle-load"—but it wasn't overweight.

By this time the German spring drive had started and the real Berthas were at work, sending their shells every fifteen minutes into Paris from positions in the Forest of St. Gobain, 64.8 miles away. But they were only a few miles from the front. We knew we could get near enough to them to drive them back out of range of Paris. We heard also that 380-millimeter guns from the German battleship *Hindenburg* had been mounted to fire upon other large French cities of strategic importance far behind the front and that sixteen heavy naval guns manned by German sailors had left their base at Kiel for Belgium. That looked like the Channel ports sure enough, and probably they were to support a German offensive there. Still more reason for hurry.

We fired our first shot on April 30, 1918, before us distinguished a company as ever saw a gun go off. A special train had brought brass hats, allied and American, some of whom at least came to see and remained to worship. They looked our new gun car over and fingered it like a new toy, but when we got ready to fire, they kind of edged away. Exploding 484 pounds of powder against the 1400-pound shell was all right on a battleship, but on a railroad track. . . And this pit affair—how firm a foundation was it?

The whole crowd was tense and anxious. "It'll wreck the foundation!" someone would whisper. "Or knock the car off the track!" Everyone stood with fingers in ears as Admiral Earle grasped. (Continued on page 124)

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Battleships on Wheels

(Continued from page 124)

the handle of the magneto and worked the firing lever.

Nothing happened! The gun didn't go off! The crowd began to whisper again and a few to grin. But one of our handy men gobs had a look at the electric firing wires and found that one of them had been disconnected. He adjusted it and again the lever was pressed.

The great gun crashed out with a noise that must have been heard in the Forest of St. Gobain. A stream of flame, a cloud of smoke, another of dust that almost hid the gun as it slid back in recoil upon the pit foundation. The dust began to settle, and—the gun was still there!

THE crowd rushed to see whether it was all there. It was. We fired more shots at twenty-five and forty-five degrees elevation. We left the pit and fired from the rails. Gun and mount acted just as predicted. It was a great victory for Admiral Earle, the Bureau of Ordnance, the Naval Gun Factory and the Madison people. On the way back to Washington the brass hats were jubilant. The Army Ordnance Department asked the Navy to build them some gun mounts like ours.

That night we pushed off for Eddystone to dismantle the gun car preparatory to shipment. We were ready to go to France!

But here the Germans butted in. Our original plan had been to answer the Dunkirk bombardment and help the British hold the French Channel ports that connected them with England. But now that the gun was a success and we should soon have mounts and locomotives and cars enough, the British had no safe place in France for us to unload them. The German drive had not yet reached the Channel ports, but the British feared it would. We could have started shipments as early as April 13, but the British could not name a French port under their control where it was safe to send them.

It looked as if the German drive had stopped us. But not for long.

If the British couldn't have us, maybe the A. E. F. would. So we offered our sword—or guns—to General Pershing. He cabled back:

"Fine. We accept with thanks. Send guns, mounts and everything to France without delay—but don't ask us how."

Of course, there were not his words, but that was the meaning, and General Pershing couldn't help it. The Army had not an extra ton of shipping to spare, not even enough for its absolute needs, in the midst of the great troop movement to France for which the Allies had appealed in their emergency. But the Navy had, and we telegraphed to our chosen gobs to assemble at the Philadelphia Navy Yard to sail. Sail they did, the first 250 men and eight officers commanded by Commander Garret L. Schuyler, to arrive in St. Nazaire June 10. Commander J. W. Bunkley took over the second draft, arriving June 25.

IT WASN'T so simple, though, to get the guns, locomotives and other equipment across. German submarines were off our coast, sinking vessels and laying mines. Their shells fell on the beach at Cape Cod. The U. S. S. *Fearl* was the first vessel we had been able to get reserved for our battleships on wheels, and on June 3, just as she was coming into port, a German "sub" sank her. Our first shipment was delayed eighteen days—until June 20—and the U. S. S. *Newport News*, carrying it, reached St. Nazaire July 5. More material came on the *Bath*, *Penelope*, *Maling* and *Rappahannock*, the last docking August 15. But a month before that I had reached France, and we had already been in battle—the battle of St. Nazaire.

Further revelations of the thrilling and inspiring inside story of the American Navy's triumphant big gun campaign in France will appear next month in *POPULAR SCIENCE MONTHLY*.



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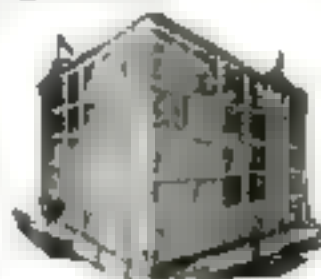
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When I first started making real important money, I used to go down to the bank, draw out a note—and just thumb it over in my office and grin. That's how good it felt to get success and big money, after years at a low-paid job.

Success and Big Money Were For Others, Not Me

*Believe It or Not, That Was What
I Thought of Myself—Just
Twelve Short Months Ago*

I'M telling you, just one year ago I'd never seen a hundred dollar bill in my life outside of a bank.

You'd think I'm kidding you if you saw the fine Radio business I own now. But it's gospel truth. Just twelve months ago I was only a poorly paid clerk, and I thought success had passed me by.

All my crowd in those days—the fellows I met in the pool-hall and at the bowling-alley—said a fellow had to have money to make money. They claimed there was no chance for a fellow whose family didn't have money or some business to start him out in. And I'd decided they must be right.

I guess at that time I had just about given up hope. I thought there must be some kind of a mystery about making a lot of money. But I was due for a big awakening. Did I get it? Oh, boy! Read my story and judge for yourself.

IT all started one day last summer, when Helen, the girl I wanted to marry, was leaving for the seashore. Of course I went to the station to see her off.

As I stepped onto the station platform Bob Oakes and Wilmer Pratt had just rolled up in their car. They climbed out with their arms full of bundles—books, expensive candy, flowers, all sorts of things. Well sir, I wished I could have swallowed in one gulp the little box of drugstore candy I had bought for Helen—it certainly looked pitiful beside all that stuff.

We three stood there talking to Helen until train-time, while Helen's mother looked me up and down. Like any young girl's mother would, she had my financial standing already sized up within thirty-five cents. Cheap suit, cheap hat, she took it all in. And you could see on her face all the time what a lot of nerve she thought I had to give Bob and Wilmer a run for Helen.

Well to make a long story short, Helen was nice, but her mother stood there looking scornful whenever she glanced my way, and she hardly spoke to me at all. I felt about as welcome as the measles, and as uncomfortable as the itch. I began to wish that I and my cheap suit and cheap hat could sink through the floor, but I stayed there and stuck it out.

WHEN Helen's train finally left, I slunk home, ashamed and humiliated. I went upstairs to my room and sat there with a lump in my throat, getting hotter and hotter and more ashamed of myself. Then I began to see red and redder.

Finally I jumped up and banged the table. "I'll show 'em," I growled through clenched teeth. "There must be some way for a man to make real money!" An idea suddenly flashed through my head.

Hastily I began thumbing the pages of a magazine on the table, searching for an advertisement that I'd seen many times, but passed

up without thinking, an advertisement telling of big opportunities for trained men to succeed in the great new Radio field. With the advertisement was a coupon offering a big free book full of information. I sent the coupon in, and in a few days received a handsome book, telling about opportunities in the Radio field and how a man can prepare quickly and easily at home to take advantage of these opportunities. I read the book carefully and when I finished it I made my decision.

WHAT'S happened in the twelve months since that day, as I've already told you, seems almost like a dream to me now. For ten of those twelve months I've had a Radio business of my own! At first, of course, I started it as a little proposition on the side, under the guidance of the National Radio Institute, the outfit that gave me my Radio training. It wasn't long before I was getting so much to do in the Radio line that I quit my measly little clerical job, and devoted my full time to my Radio business.

Since that time I've gone right on up, always under the watchful guidance of my friends at the National Radio Institute. They would have given me just as much help, too, if I had wanted to follow some other line of Radio besides building my own retail business—such as broadcasting, manufacturing, experimenting, see operating, or any of the score of lines they prepare you for. And to think that until that day I sent for their eye-opening book, I'd been wailing "I never had a chance!"

NOW I'm making real money, own a good car, stand high in my town, can borrow money at the bank any time I might want it. I'm getting some real fun and enjoyment out of life, not just existing from pay-day to pay-day.

And—just listen to this! Bob was in my place only the other day, and asked me for a job! Wilmer is still getting along pretty well

on his father's money, but he'd trade places with me any day.

And Helen? Well—the honeymoon will be spent in Honolulu, starting two months from tomorrow!

HERE'S a real tip. Think it over—are you satisfied? Are you making enough money, at work that you like?

This new Radio game is a live-wire field of golden rewards. The work in any of the 80 different lines of Radio, is fascinating, absorbing, well paid. The National Radio Institute—oldest and largest Radio home-study school in the world—will train you inexpensively in your own home to know Radio from A to Z and to increase your earnings in the Radio field.

Take another tip—No matter what your plans are, no matter how much or how little you know about Radio—clip the coupon below and look their free book over. The information it will give you is worth a few minutes of anybody's time. You will place yourself under no obligation—the book is free, and is gladly sent to anyone who wants to know about Radio. Just address J. E. Smith, President National Radio Institute, Dept. I-M, Washington, D. C.

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Death in Your Garage

(Continued from page 10)

he running along back to the garage now." Gus poked his nose out of the door and then drew back shivering. "Certainly is cold. Where the dickens is my coat? Funny I can't seem to locate it. I'll have to borrow one of yours."

"Right there in the closet, Gus," said Enaley. "Take anything you want. I'm sure grateful to you for pulling me out of this mess, but still I can't figure out how you knew what the matter was."

"Don't worry your head over that," Gus growled as he went out.

"Where was the fire?" Joe Clark inquired facetiously when Gus got back.

"It wasn't any fire," replied Gus. Then he explained what had happened to young Enaley.

"I didn't know gas worked that quick," said Joe.

"Any kind of poison gas works quick," explained Gus, "but most kinds have a smell that acts as a warning. Carbon monoxide is practically odorless. That's what makes it so deadly. You don't realize you're being gassed until you feel a trifle weak, and then you pass out cold."

"OF COURSE as far as the carbon monoxide that comes out of a motor exhaust is concerned, you have plenty of warning in the smell of burned oil, but everybody is so used to the smell of an exhaust that nobody pays any attention to it any more."

"What I can't understand," Joe interrupted, "is why there are so many cases of carbon monoxide poisoning now when there weren't before, when I was a youngster."

"Well, in the first place," Gus explained, "the gasoline they sold in those days was big test stuff. It burned so easily you didn't need hot spot manifolds or even a hot air supply pipe to the carburetor. Of course carbon monoxide gas was produced, but in much smaller amounts than nowadays, when the stuff you get for gasoline is so hard to burn that until the motor is fully warmed up there is a whole lot of carbon monoxide produced."

"Of course," Gus continued, "these gas poisoning cases happen mostly in winter, because in summer doors are just naturally kept open, and the hot weather lets the motor heat quickly to the point where the carbon monoxide isn't so serious."

"YOU can get gassed without running a motor indoors in winter. A fellow nearly got killed last week by carbon monoxide driving along the road. He had one of these exhaust type car heaters on the floor just behind the driver's seat. The pipe worked loose and the gas leaked out so gradually that he didn't notice the smell. He had the windows all closed because it was cold. Luckily he succeeded in stopping the car and opening the door and then he did pass out, but the cold air brought him around."

"The same thing must happen when there is a leaky point in the exhaust manifold," Joe suggested.

"But that isn't nearly so serious," Gus said. "Most auto dashes are so tight that not much gas can get through from under the hood into the driving compartment. Still, some does get through, and to be on the safe side it's always well to make sure the exhaust manifold gaskets are good and the bolts are tight. Many a mysterious headache probably could be traced back to gas from a loose exhaust manifold connection."

"Seems to me keeping one of the windows open a bit ought to take care of that," said Joe.

"Sure," Gus agreed. "It's better to risk a cold in the head than gas poisoning if you begin to smell exhaust fumes inside the car while you're driving."

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Gems That Work for a Living

(Continued from page 132)

one of the greatest of scientists, was able to heat black diamonds in air and oxygen until they burned away, leaving a very light ash which he found consisted of iron, lime, magnesia, silica and titanium. Unlike almost all solids, which melt when hot enough, pure carbon passed directly into a gas. He was able to apply a pressure of 170 tons a square inch, the weight of 330 light automobiles, without crushing the diamond. Yet it is only one sixth as dense as gold. Using a sharp pointed splinter as a plane, he reported that he could "plane curls off a glass plate as a carpenter's tool will plane shavings off a deal board."

Chemically, he found, diamonds are almost identical with charcoal, graphite and lamp-black. He decided that enormous heat and pressure should produce diamonds from the pure charcoal of sugar. Into a carbon crucible he placed the charcoal and pure iron. He heated it to more than 7000 degrees Fahrenheit, and the iron went off into a gas. Then he plunged the white-hot vessel into water. As the outer layer solidified with cooling, the inner molten mass was subjected to tremendous pressure.

WHEN it was entirely cooled, he found a bulky residue of graphite, flakes of carbon, and a black, dense substance. This residue he heated, treated with various acids and reheated until all of it was dissolved except a sort of scale and tiny crystals, along with some black particles. Tests showed him that the crystals were identical in luster, form, optical properties, density and hardness with natural diamond gems. The black particles proved equal to Brazilian carbonadoes.

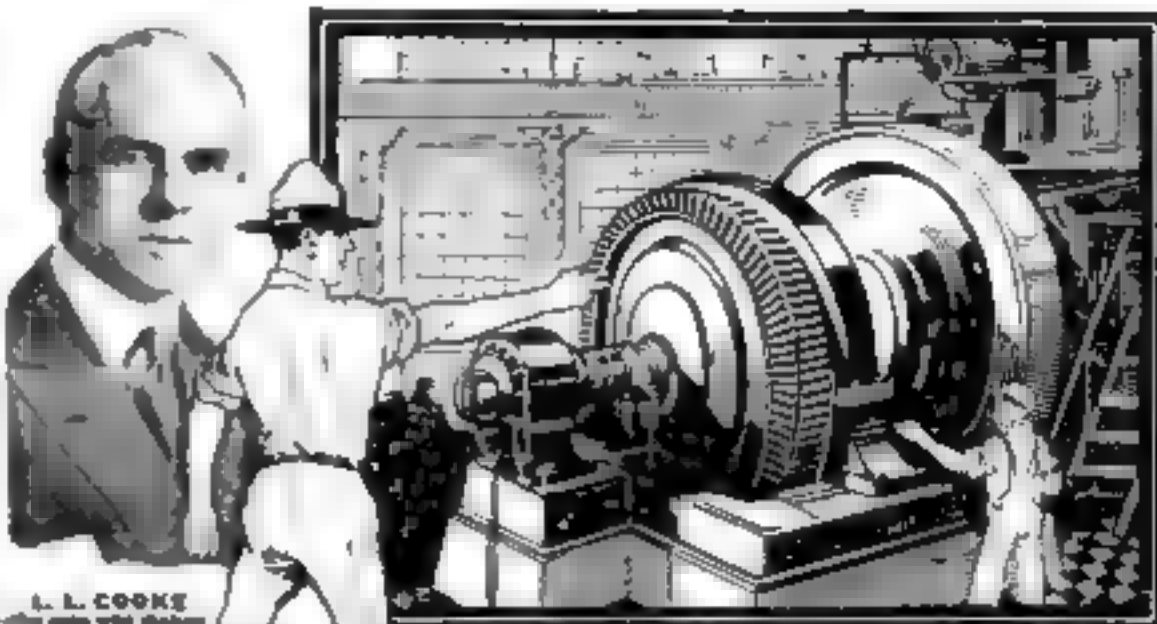
Since then others have produced similar diamonds, but they are still extremely small—it would take two of the largest to span the head of a pin—and the cost is prohibitive.

Brazil's carbonadoes are indispensable today for the speedy cutting of hard rubber, bakelite and fiber compounds. Their absolute precision is especially valuable in turning such instruments as high-power telescopes and microscope tubes.

With black diamonds, rubies, sapphires and semiprecious stones are cupped, drilled and formed for use as frictionless bearings. Glass, marble, porcelain and the hardest compounds yield readily to pure carbon.

I asked one diamond drill expert how deep we might expect to penetrate into the earth. With present means, he said, the limit probably is three or four miles. The steel rods which transmit the rotary power from the surface have an elasticity which in very deep holes probably will cause them to buckle. The deepest well so far has not quite reached two miles. Twice this depth will give us far greater knowledge of the earth's interior, its stored heat, its rocks and minerals. With larger bits and rods, diamonds may some day penetrate into the solid nickel-iron which our sphere's magnetic behavior indicates comprises a large part of the interior.

ALTHOUGH Brazil furnishes the world with its carbonadoes, that need not deter us from seeking them in this country. A few are said to have been picked up in Pike County, Arkansas, where brilliants are also being mined to a limited degree, and gems up to six and a half carats have been found. Single diamonds, white crystals, have been picked up along the eastern base of the Appalachian Range, in Virginia, North and South Carolina, Georgia, Alabama, and along the path of the glacial drift in Wisconsin, Michigan, Indiana and Ohio. Others have been found in California, Idaho and Montana. The largest diamond was picked up by a laborer excavating in a street of Manchester, Virginia, in 1855. It weighed twenty-three and three quarter carats.



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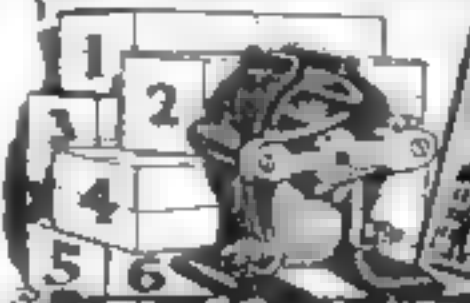
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Making Money Out of Scraps

(Continued from page 39)

materials. Yes, and the set when it was delivered came packed in a dustless excelsior now being made from shredded old newspapers!

My family and I are surrounded by scraps from lumber mills. That attractive oatmeal paper on the walls is covered with tiny shivers of chewed up wood waste. The linoleum is composed mostly of wood floor made from scrap wood, perhaps mixed with some of the powdered cork waste formerly used. Picture frames, checkers and wooden toys are composed of wood floor made into a paste.

"They even use it in dynamite," said the chemist. "And did you know that sawdust is being turned into a rival of coal as fuel? The Government Forest Service has just developed a method of making sawdust briquettes that have three fifths the fuel value of good coal."

SCRAPS from the iron foundries come to new life in the gas range, the furnace, and the radiators. When a foundry buys scrap nowadays, it gets everything from old tools to stoves, bolts, machines, and steel wheels from railroad cars. These go into steel and iron castings.

"I know a foundry," the chemist told me, "that has saved \$10,000 a year by reclaiming junk."

He reminded me of the enormous achievement of Henry Ford in tearing down 100 wartime steel merchant ships, purchased from the Government, and literally transforming them into automobiles, tractors, and machinery for his vast plants. Even the smallest bits of the vessels, such as nails, were put to use somewhere. Steel and other metals were converted into automobile parts, brooms and spars were turned into car bodies and wheels, scrap wood and cork were ground for packing purposes.

"I am assured that today the Ford salvage department," he said, "is saving more than a million dollars' worth of products a month, from waste paper to paint left on the insides of cans which, by the way, amounts to 500 gallons a day."

"Another plant I know of, a forge shop, buys old axes from railroad cars, which are of the finest steel, heats them white-hot and steam-hammers them into ship anchors."

"I SUPPOSE you know, too, of the recent successful tests by the Delaware and Hudson Railroad, in which metal ties welded from old worn rails proved ten times as strong and cost less than ordinary wooden ties."

A basket of groceries on the kitchen table reminded me of the vast amount of waste paper and old rags used in containers of all kinds, as well as writing and wrapping paper. On the average the paper is made half of waste and half of wood pulp from spruce and other lumber. Linen rags have an important place in making high grade paper. The U. S. Forest Products Laboratory has just developed a process for de-inking newspapers by using clay, the first cheap process that leaves the paper clean to use over again. By salvage of this kind tremendous areas of spruce are being saved.

My garage, I learned, is lined with wall-board made from the pulp of old paper. By a new process this pulp is mixed with gypsum and water and rolled into strong board, the surfaces of which are formed by "chip paper," made from waste paper and waterproofed. My attic, too, is finished with another kind of insulating wall-board made of sugar cane.

But while chemists and manufacturers are thus saving me money by restoring cast-offs, I found that I and thousands of other householders are guilty of extravagant waste. In my city, garbage is dumped into the sea, but in some forty American cities the refuse is used. It is rich in ammonium salts, nitrogen

and phosphates, the bases of all fertilizer. Meat bones are used to make gelatin, glue, fertilizer, and soup cubes. I was told, too, that a German engineer, Kurt Gerson, has just announced plans for reclaiming all the cellulose matter in garbage, and converting it into gun cotton, artificial silk and other products. He also distills potato parings and waste wood, recovering tar, charcoal, acetic acid and other useful products.

In the United States the Goodwill Industries have householders save up trash in bags. In Seattle, for example, some 15,000 bags have been distributed. The contents are sorted, fumigated, repaired, reclaimed, and sold, giving useful employment to jobless men and women. The same idea in the Ford plants gives work to 800 people.

Only recently an engineer developed a way of salvaging the salty water which often is a costly nuisance in Oklahoma oil wells. By processes of evaporation he has obtained salt, bromine and iodine, pigment for paints, epson salts, and ammonia compounds. A chemist in Japan has found a way to decompose discarded silk threads into a jelly, which he draws out into new silk threads. And the makers of rayon do likewise with waste wood to make artificial silk.

"YOU'D think that the soapy water that runs down your drains could not possibly serve a useful purpose," said the chemist. "Yet a yarn mill in Germany is converting soap waste into a gas with three times the illuminating power of coal gas. Another plant obtains very good gas by fermenting tanks of city sewage."

An experimenter in Minnesota is making disinfectants, fly spray, paints and charcoal from straw smoke. A ton of straw yields fifteen gallons of oil, 540 pounds of charcoal, and some 400 pounds of pitch. Then, in larger smelters they are using electric processes to salvage the fine zinc, lead, copper and other particles in the smoke, and making a handsome profit. In a cement works the polish recovered in this way is almost as valuable as the main product. The Ford plants recover about fifty tons of ore dust a day from their blast furnaces, which is fused and sent back as almost pure iron. They also reclaim the waste heat in five gases and use it for drying purposes.

"Aren't we going to have any more products that are really new?" I asked.

"We'll have them only until we can find substitutes," my friend replied. "Wherever chemists can find suitable substitutes at lower cost than the original, they are adding to our wealth."

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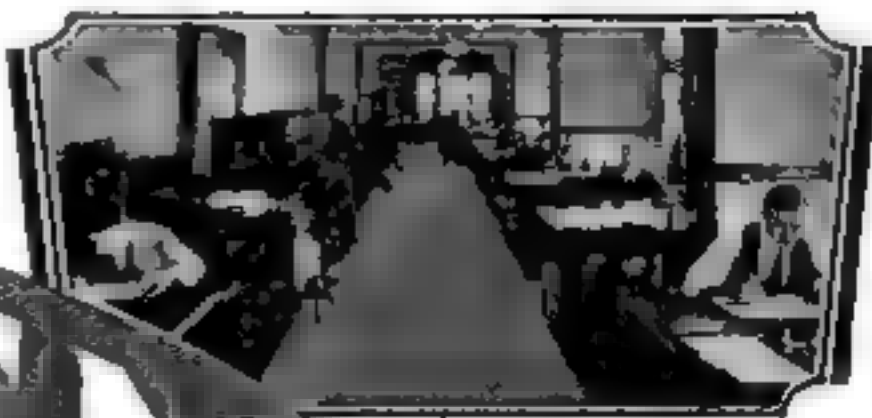
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Invention—Hobby of Great Men

(Continued from page 35)

Vanderbilt, is well known among railroad men for his inventions. He was trained as a mechanical engineer, and the Vanderbilt locomotive firebox has been for years standard for certain types of locomotives, yielding an income which materially augments that from the estate he inherited.

The latest Cornelius Vanderbilt, the General's son, figures as the patent office records as the inventor of a shoe polishing device, patent No. 1,368,073, issued February 5, 1921. His application describes it as about the size of a large fountain pen. Inside the tube is a pulley, which feeds into a brush attached to one end, while concealed within the tube, wound up like a roller shade, is a polishing cloth which can be readily withdrawn. It is not of record that this device has ever been placed on the market.

COL. JOHN JACOB ASTOR, who went down with the *Titanic*, patented a device for cleaning man-made roads on the general principle of a vacuum cleaner, doubtless the result of his experience with dusty roads about his country place at Rhinebeck on the Hudson. Col. Astor's patent, No. 514,203, issued February 12, 1904, was dedicated by him to public use without compensation, this gallant gentleman, like Washington and Jefferson, declining to accept money for his invention. No one, however, put the device to the test.

It is a long jump from Astor and Vanderbilts to Jack Johnson, the Negro pugilist, but they are in the same class as amateur inventors. On April 18, 1923, while John Arthur Johnson was serving a term in the Federal Penitentiary at Leavenworth for violation of the Mann Act, patent No. 1,612,171 was issued to him for an improved type of monkey wrench.

Prince Henry of Prussia, brother of the former Kaiser, took out United States patent No. 1,081,604 on May 2, 1914, just three months before the great war began, on a windshield wiper for automobiles.

Automobile devices are among the favorite inventions of amateurs. Josef Hofmann, the famous pianist, invented a steering stabilizing device, patent No. 1,637,873, dated June 3, 1925. In *Popular Science Monthly* for May 1927, some of Mr. Hofmann's other inventions, including collapsible chairs and an automatic piano-player were described. He has always been partial to automobiles, and thirty-four years ago built one of the first steam-propelled cars in Germany.

CHARLES RAY, motion picture star, patented on May 20, 1919, a combined automobile direction indicator and mirror to be mounted on the left front fender, or wherever the mirror best reflects what is following, and contains three electric light bulbs behind glass bearing lettering which becomes visible from behind when the lamps are switched on. By pressing the proper button the driver can signal "Right," "Left," or "Stop" to following cars.

Women as inventors run largely to feminine or juvenile devices. Mrs. Winifred (Hudson) Guglielmi, who explicitly states in her application for patent No. 1,573,383 that she is "professionally known as Natacha Rambova," patented a "combined overcoat and doll" on March 2, 1926, shortly before the death of her famous former husband, Rudolph Valentino.

One of the most prolific of women inventors, an amateur, is Mrs. Horatio Nelson Slater, a leader in New York and Boston society with a country place at Bar Harbor. Her two sons will eventually come into \$80,000,000 left by their father, and her personal wealth is estimated at \$7,000,000. The profit from her inventions she has devoted to charity.

Several of Mrs. Slater's patents relate to dolls; eyes that move sideways as well as up and down, movable eyes for rag dolls, dolls with savings banks in their heads, atomizer dolls which spray perfume, dolls' hair, smoking dolls. Mrs. Slater is also the patentee of a tape measure holder and pouch, a cover for loose-leaf folders on books, a military blanket, an automatic air gauge for refrigerators and a combined couch and chair.

Henry Ford patented a transmission mechanism for railway automotive vehicles. David Wark Griffith, improvements in the art of making motion pictures. Bob Fitzsimmons, a new type of punching bag support. Benjamin F. Whitte, owner of the Philadelphia Athletics, a method of making hamlets, and Eugen Sander, famous strong man, a strength testing device.

These inventions cover only the natural by-products of the men's occupations, but when we find the late Oscar Hammerstein, theatrical magnate and grand opera impresario, with a whole shelf of patents on cigar-making machinery to his credit, we wonder "how come" until we learn that cigar-making was Hammerstein's first occupation. Some of the success he met in the most sumptuous opera of modern times came from his machine which supplanted most of the hand labor in the manufacture of cheap cigars. Something else he is said to have made by originating the safety drain that prevents bathtubs and lavatories from overflowing.

Professional inventors going outside their fields sometimes produce devices of little or no practical use. Thomas A. Edison took out a patent, No. 870,816, on September 30, 1910, for a flying machine of the helicopter type. It never flew and never will.

BUT an Irish horse doctor, John Boyd Dunlop, invented the pneumatic tire. A Pennsylvania Quaker, William Foster, invented the now universal crown stopper for bottles. Christopher Sholes, inventor of the first practical typewriter, was a printer. The automatic telephone was invented by a Kansas City undertaker, Almon B. Strowger, who thought a rival had bribed telephone operators to hang up his calls.

It was a New Jersey preacher, Hannibal Goodwin, who revolutionized the photographic industry and made motion pictures possible by the invention of the celluloid film for making negatives. The first machine for knitting stockings was invented in Queen Elizabeth's day by William Lee, a professor at Cambridge.

Among the more or less famous persons in other fields of activity who figure also as inventors we find Maude Adams, actress, working in the laboratories of the General Electric Company at Schenectady to perfect a device for showing motion pictures in full color by daylight. Herbert L. Satterlee, brother-in-law of J. P. Morgan and former Assistant Secretary of the Navy has his private laboratory in which he works on X-ray and radio inventions. William C. McAdams, baronet, has fingers at a power by picking up a metal thermos bottle cap-cup full of hot coffee, and invented a heat-proof cup.

Everybody is an inventor, actual or potential, and a good many of the amateur inventions actually work.

Coming next month — "Whistle-Punk," a realistic short story of life in a logging camp, complete in the February issue. The author, Paul Conradt, sets down vividly the thrills and drama of the lumberman's exciting career as he has seen it.

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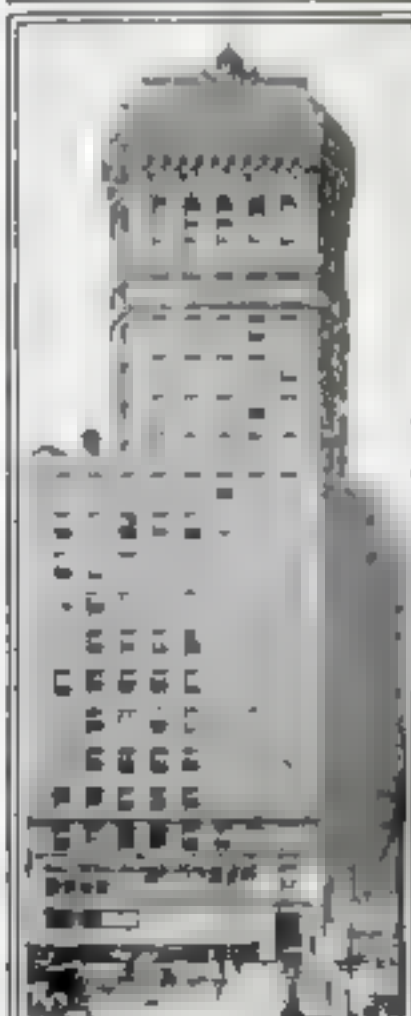
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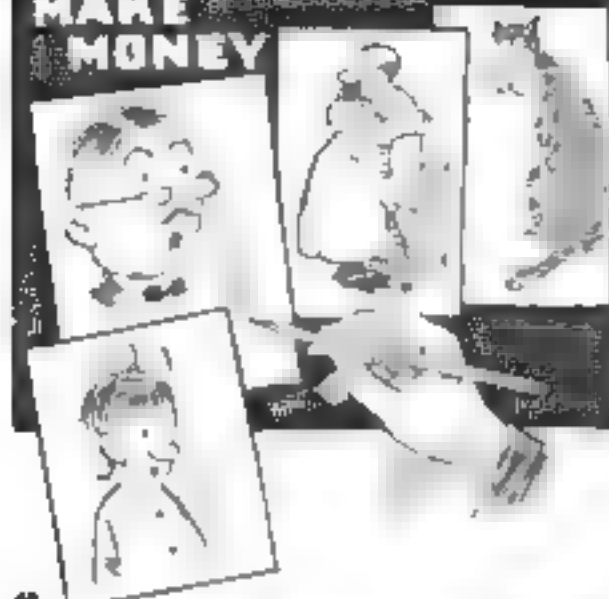
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Success or Failure—

(Continued from page 15)

in more happier situation. We avoid difficult decisions by postponing them. And yet we fail in we how these mere habits, often trivial, loom to mountainous obstacles on the path toward success. Even if we saw this truth, we'd probably say with resignation that such habits can't be changed. But they can.

For evidence, let's turn to Walter Brandt. Walter was a spoiled only son exactly like Joe. When he grew up his parents found him an insufferable that they got rid of him. They sent him away to school.

Lucky the school was of an unusual kind. The boys lived in the open, and out their playground, raised their own vegetables, milked the cows, got their meals, washed the dishes, made their beds. They published a magazine, taught the younger boys—helped to run the whole school. Their studies of arithmetic, geometry, English and science were means toward the pleasurable end of discharging these responsibilities.

SO THEY not only learned facts, but they learned to cooperate, to think straight and to convert their thoughts into deeds.

Most important of all, they were forever working with tools. You can't develop very serious daydreaming habits if you have highly developed long-using habits.

I needn't tell you what this vastly changed environment did to Walter.

Now the important problem for most of us is that our folks have raised us in some respects as Walter's did, and we can't alter our environment, as his was altered, to rid ourselves of unfortunate habits. What shall we do about it?

Recent laboratory experiments in child psychology may furnish the answer. There it has been found that it is less feasible to try to "break" a child of habits by punishing him than to simply "uncustomize" the habit.

For instance, here's a child who has been several times knocked down by a neighbor's woolly white dog. Being knocked down—loss of support—is an unlearned or primitive fear. This small child's fear of being knocked down became associated with white, furry things. He now shrinks if he sees a white rabbit.

LET'S see how the psychologist "uncustomized" the rabbit fear in the child.

Watson got the child comfortably settled over a tasty lunch at one end of the room. Then he had the rabbit brought in at the far end of the room. The child whimpered a minute, but the rabbit came no nearer, and the food tasted good. On successive days, the rabbit was brought closer while the child ate. And finally the child was actually fondling that once dreaded rabbit with one hand while he ate with the other.

"All right, you may say, 'I see what these habits are and how they were formed and how they may be altered. Can't we find more order in our habits—some key habit system to take up first?'"

I think we can.

Follow your acts through the day. When you get up in the morning do you take five minutes of brisk exercise and a shower, dress neatly and go down to work clean-shaven and clear-headed? Perhaps your neighbor may be late in bed, bolt a cold breakfast and rush off to work sleepily dressed, heavy-headed and unshaven till noon.

In our relationship with our fellows is a second habit system—the social habits. We greet people and work with them sanely or gloomily only as a result of acquired habits of action that we rarely think about.

Thirdly we have a system of work habits. Some tackle the day's job as soon as they get to shop or office. Others fume around first

Fourthly we have a system of thinking habits. Some play yes-man to the chief, follow all the office traditions, and make decisions on the basis of rumor, gossip or prejudice. Others look the actual facts of each problem full in the face.

Finally, as we go about our day's work, we show either possession or lack of a fifth and very important habit system, which consists of inventive habits. The fellow who sticks in the rut is the fellow who always does the same thing in the same way. The fellow who gets ahead is constantly trying to do useful things in new and better ways.

So here are five key systems of habits: bodily habits, social habits, tackle-it habits, fact-facing habits and inventive habits. If we're deficient in any one of these systems we shan't succeed as well as the fellow who isn't.

"Ah, but," you say, "we're told you can't teach an old dog new tricks."

It appears, however, that we were told wrongly. During the last two years Professor E. L. Thorndike, of Teachers College, Columbia University, has conducted experiments with a group of adults averaging 42 years of age and a group of people averaging 22, and he has compared their learning ability with that of children. In general, both adult groups learned more rapidly than the children, and the speed of the 42-year-olds was only about one sixth less than that of the group averaging 22 years.

SUCH experiments seem to show that while we've lost the habit of learning, through disuse or distaste, we haven't lost the ability to learn. Why should we give up hope of acquiring more useful habits or of altering whole habit systems that hamper us?

I don't believe we should, because I've seen such habit systems frequently changed in others, and I've changed them in myself. Any crisis in your life is a good time to do it—when you are graduated from school, when you get your first job, when you marry, when you lose your job.

And the way to go about it is to take an inventory of your five key habit systems by observing your own actions in the course of the day's work. You'll pick out fairly easily the crucial habit system in your own case. Set aside six months to alter just that one system of habits.

I know a man who had gotten well along toward middle years coddling himself, afraid he had a weak heart.

It chanced that an insurance physician found his heart in perfect condition. About the same time the man bought a radio set. He got up one morning to do the radio calisthenics. That morning's brisk exercise under pleasurable conditions with stimulating music brought physical exertion into new associations for him. He kept it up. Now he plays golf, swims, and rows, and of course all his other habit systems have correspondingly improved. He was on his way to being a failure at fifty. Now he's looking forward to greater success at sixty.

DO YOU see how stage setting helped? Doubtless you can devise ways to set the stage for the correction of your own maladjusted habit system. An excellent way, after you've discovered what habit you had best alter first, is to tell everybody what you're going to do. Boast about it. The natural impulse to preserve your self-esteem will help you over the hardest part.

And of course, when the new set of responses is under way, the pleasurable accomplishment associated with them will itself become part of the stage setting that will lead to the strengthening of the altered habits.

Why Don't We Fly?

(Continued from page 55)

clinging to a sinking machine, while other airplanes, again, have burst into flames aloft (backfires are a sheer terror) or lost vital parts of their framework, broken off in mid-air.

One pilot was shot in the back of the head by a mad passenger, but that was an exception! The channel crossing being one of Europe's stormiest passages, pilots have often to fight every inch of the way. Captain Barnard, England's best flyer, killed the other day, once said to me on our descending at Croydon: "I had to hold her the whole way over." So had Wilbur Wright to "hold her"—but that was in 1908.

On all flights, no matter who the pilot, one feels that the reliance that must be placed on the human element is definitely unacceptable. Nevertheless, let not this indictment obscure the fact that the airplane, even as at present most imperfectly constituted, is a highly useful accessory in Europe today, enabling adventurous business men to dash from capital to capital—also jockeys and prima donnas and statesmen.

BIG flights, quite wrongly, cloud everything—and have done so this last year more than ever before. Appealing to the imagination by their "death of glory" touch, these essentially military performances were revived four years ago when Captain Dossy startled the world by racing from Paris to Shanghai, via India, in under ten days. Prior to that, away back in 1910, Alcock had flown the Atlantic without stop, and Ross Smith had gained Australia from England in twenty-eight days—two feats comparable with everything done more recently, save Lindbergh's exploit, which stands alone.

In sober fact the year's events have demonstrated, first, the grievous peril and handicap of enormous gas tanks, and second, how utterly even the stoutest and most powerful machine still remains at the mercy of the elements. In many more instances than the contrary, the year's big fights have been mournful failures, as is shown by the following tabulated list:

Captain Finck, Sikorsky biplane. Overturned at take-off, New York, and caught fire. Wright of gas too heavy. Two dead. Point raised: Are war "aces" the kind of men to carry through patient, "safety first," pioneer peace flights?

Colonel de Pierola, Italian amphibian. Many vicissitudes in hemisphere-to-hemisphere flight culminating in engine failure on return journey off Azores and three-day tow into port. Engine had failed several times previously.

NUNGESSER and Calk, *Prieres biglames*. Many were in tears at Le Bourget, Paris, when these two gallants took off on their "suicide flight." No floats, no wireless, no previous experience of aerial navigation over the ocean. Last seen flying out over Ireland en route to New York. Probable engine trouble, or lost way or struck water in mist. The huge 450-horsepower engine being part of the fuselage, the *White Bird* would have sunk like a stone. Nungesser was another war "ace," and a wild one at that.

Sir Alan Cobham, de Havilland biplane. Took six months getting to Australia and back, from England, but was surveying. Reported flying impossible east of Calcutta in monsoon period. That is, three months a year.

Captain de Mounayes and companions, biplane. Flying from West Africa without orders and against French Navy Department's instructions. Wreckage of Mounayes' machine was found weeks later off Brazil. Crew had evidently turned one wing into a sort of raft.

Colonel Lindbergh Ryan monoplane. New York-Paris, solo. The only flight executed in its entirety according to plan. Motor good, machine good, man transcended both. Had favoring wind, but the (Continued on page 110)

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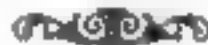
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Why Don't We Fly?

(Continued from page 141)

been traceable to "Lindbergh mania," and that it will doubtless mark the same milestone in flying that the ill-starred Paris-Madrid race did in motor racing in 1903—when half of the competitors were either killed or injured, including Renault, and road racing was ever afterwards controlled. And the successful Honolulu flights do not balance the record.

I now come to the more popular side of this inquiry, namely: Why don't WE fly—you and I and all of us? Why hasn't the airplane caught on like the automobile? Why haven't we got hangars as well as garages? Why don't we "take the air" instead of crowding together along the highway in promiscuous procession? Is it that the air is definitely not man's element? Or that the risks are too big? Or the cost? Or is it that the air is purely and simply—*dull*?

One observes that Colonel Lindbergh, supported by the Guggenheim Foundation, is preaching the gospel of safety far and wide, and naturally enough every syllable that a Lindbergh utters must be respectfully listened to, but I, for one, cannot see in any circumstances this generation taking to the air en masse, and in this view I believe I am in the good company of Orville Wright and Edison.

THE plain truth is that the average person doesn't miss being out of the air one wee bit, and what the average person doesn't miss he or she is not going to chase. There are many reasons for this supineness, other than mere danger. You can get as sick in the air as ever you can in the worst rock-ribbed. Except in the new cabin airliners—when you might as well be sitting in a Pullman with far less risk—you cannot hear a word that anybody shouts at you. The vibration of the engine and its din are positively nerve-shattering. The boredom of the air is complete—hence most people try to read stuff, but Lady Hester, the British Air Monster's wife, going to India. Chronic crabs and deafness are frequent among air travelers. Air bumps, when a ship sails three or four hundred feet without warning, are not by any means rare. And what is there to do or see or say as you go speeding through the heavens? True, a bird's-eye view unfolds itself on clear days, but there is no charm, no propinquity, no enjoyment of the countryside about such a skimming through the firmament—even a mountain looks flat. Where, too, is the cherry roadside inn where one may pull up, or the riverside meadow where one may picnic? Just grass and oil and din and wind and danger? Personally I believe, too, that there is a growing psychological reaction against speed of all kinds as a method of enjoyment that people are coming increasingly to realize that more satisfaction can be extracted from "going no one's flat feet" than from careening about the place, numbed and seeing nothing, one's limbs cramped but that may not be so. Quite certainly, however, where the automobile errs in depriving us of the real joys of the countryside, the airplane errs a hundredfold more, and must always err.

THEN take the matter of cost, upkeep and fitness to pilot an "air flier" such as the one Henry Ford is putting on the market or the already existing British Moth. As a sport for reckless youth, this air flier may catch on a little, but what of the vast majority?

In the first place, the "air flier" will cost about six times as much as a small automobile, and one's life insurance will go soaring. Again, the owner-pilot would have to be a qualified mechanic, always tinkering with his machine, keeping it up to the mark—or else tragedy lies ahead. The cost of gas, oil, parts, and so on would be proportionately large.

And as for fitness, no one has ever suggested that air piloting is a job for anyone approaching middle age—most. (Continued on page 143)

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Why Don't We Fly?

(Continued from page 142)

experts will tell you that thirty-five is about as old as one may be.

But, none the less, let us imagine Smith up in his machine. He has kept fit and on the water wagon. He has labored unceasingly in his hangar. He has saved and saved to indulge the new sport. He has even risked taking up his wife and children for a Sunday outing (and how many husbands would risk that?). Yet what does Smith get for all this? Excitement, a rare sense of exhilaration—maybe. But supposing he contrives to effect safely a picnic trip of, say, 500 miles out and 200 miles home—what has that headlong rush through the ether availed him and his, even if all escape the drawbacks of flight enumerated above—sickness, deafness, numbness and the rest? And, eternally hovering over every civilian flyer, there would also be the grim specter of death. It is idle to argue, in this connection, that the air is as safe as the road. On the rare occasions when something goes wrong on the road one just gets out and puts it right. When something goes wrong aloft—even a tiny bit of grit in the engine—one has got to come down forthwith and find a landing place as best one can at fifty or sixty miles an hour, unless one be an expert in the "crash-landing," which few amateurs ever could do.

IT IS this ever-present nightmare of the forced landing, coupled with the knowledge that the slightest false move or rupture of the controls or framework may hurl one to instant death, that damps the present airplane as a serious "average man" proposition. In our time, in fact, hardships are laid not made. Lindbergh took naturally to the clouds just because he had something in his make-up bearing him that way, which we have not got and never shall have. Doubtless it is difficult for Lindbergh to understand this, but it is so. Why, following the same line of thought should a matron like the Duchess of Bedford (or the late Princess Wertheim) take to the clouds when only two other women out of all England's twenty million are flying regularly with them Mrs. Lynn and Lady Bailey? Why are not all our daring young women up in the air too? There can only be one answer in the vernacular, they are not built that way.

And yet what the Duchess does has served in it. I met her recently at Venice when she was flying through Spain and North Africa trying to photograph eagles. She has a twenty-horsepower Moth, a tiny thing which "does not fly" and she retains a brilliant young pilot named Barnard who pilots everything from day to day taking no risks. Yet he confessed to me that even after fastening an additional gas tank on one wing he could muster only fifteen gallons, which necessitates a landing every 100 miles. Barnard told me flying had come up against a stone wall and that we must wait on the appearance of a new electrical wizard for a further step. Which brings me to my last point, the future.

PROPHECY is not in my line (which does not mean that I am about to embark upon some). But an intelligent lumping together of the best recent thoughts upon flying, followed by an extraction of near-future probabilities therefrom, is another matter. Take what H. G. Wells has to say—the fellow who wrote about the last war in the air twenty years before it occurred. Wells thinks that mechanically we are on the right track but that we have been the veriest pygmies in regard to organizing aerial dominion. He wants England alone to spend \$250,000,000 a year on laying out, equipping and sustaining a mammoth public air service teeming with reserve pilots and machines so that when anything goes wrong there are immediately a substitute man and machine standing by. Then he goes (Continued on page 144)

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Why Don't We Fly?

(Continued from page 145)

off into politics and war. As far as our having only been inclined to nibble at things is concerned, Wells is probably right enough, but it is difficult to understand why he supports the gasoline engine. It is really this that has blocked out aviation. Any impartial pilot will tell you so. In Europe the big gas and engine firms are well aware that their combination has been found grievously wanting, and that is one reason why we are seeing so many record-breaking attempts. These firms do not want the truth to get out and are financing these flights in the hope of dazzling the public. Yet the record of the gas engine is there for all to see. To get any distance at all, passenger-carrying planes, freight machines have been ruled right out as hopeless commercial losses. Have to take on board immense loads of petrolous gas, for the carrying of which engine power has to be correspondingly sacrificed in bulk, and these machines continue still to explode or crash miserably and when in the worst expert hands—a vital point being that after such a disaster the machine is usually such a mess that inquiry into the cause of the smash is out of the question.

DESPITE enormous helicopter study, no advance has been made toward rising directly from the ground or alighting equally directly, seemingly the main intermediate hope of safe landing, while equally profound research has failed to produce a noninflammable or engine of the Diesel order.

So that powers are willy-nilly thrown back upon electricity for a solution. The day, perhaps far distant, perhaps close up—that an electrical contrivance is invented by which power can be either transmitted aloft to a machine, or, better still, actually harnessed in by the machine—our progress through the ether—that day will be the real letter one we are all waiting for. Then it will not be necessary to come down on the slightest mishap supervening; forced landings will be a night mare of the past.

Yet another invention will also have to make its appearance—some device on the parachute principle by which a machine may remain suspended indefinitely aloft when something goes wrong. A greater incentive will also be given to flight by the laying out of landing fields right and left. In this connection an Englishwoman, Mrs. Egan, not long ago performed the extraordinary feat of effecting nearly 100 landings during a 1700-mile flight around England between sunset and sunset. Only thirty of these were on airfields and she did it to try to impress upon scores of cities the drawing value of landing grounds.

ON THE other hand Sir Alan Cobham's efforts to secure the British one and all into Moths for their better health and spirits have fallen as flat as a pancake. Nothing doing in the tight little island where heathenish climate and short distances, incidentally, militate strongly against civilian aerial expansion.

Rather may we look for developments in the great open spaces of Australia, South Africa and along the route to the East, the airplane's true domain, spanning vast distances in equable conditions. In like manner, Chamberlin's hop from the Levant to was in the strictly practical vein. There is no reason whatever why future ocean "greyhounds" should not have half a dozen hangars stowed away forward, likewise a runway from which postal machines, with passenger accommodation, would systematically hop ashore, in fine weather, from as much as five or six hundred miles out. Here, indeed, we revert to the true current reality of the airplane-in-process in its present form as a useful accessory. But as an independent means of transport or purveyor of pleasure for the multitude . . . no

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Answers to Sam Loyd Puzzles on Page 66

Oldest Puzzle in the World

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15	10	3	6
4	5	16	9
14	11	2	7
1	8	13	12

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Coats, Vests and Trousers

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Weight of a Bottle

If we add a tumbler to both sides of the middle scales, then the two upper weighings will be alike with respect to one side, which fact, on the axiom that "things equal to the same thing are equal to each other," will establish that a pitcher is equal in weight to two tumblers and a plate.

Substitute 4 tumblers and 2 plates for the 2 pitchers on the bottom scales, and we then have 4 tumblers and 2 plates balancing against 3 plates.

Remove 2 plates from both sides, and we thereby prove that a plate is equal to 4 tumblers. Substitute 4 tumblers for the plate on the middle scales and it is revealed that a bottle is equal to 3 tumblers. Five minutes.

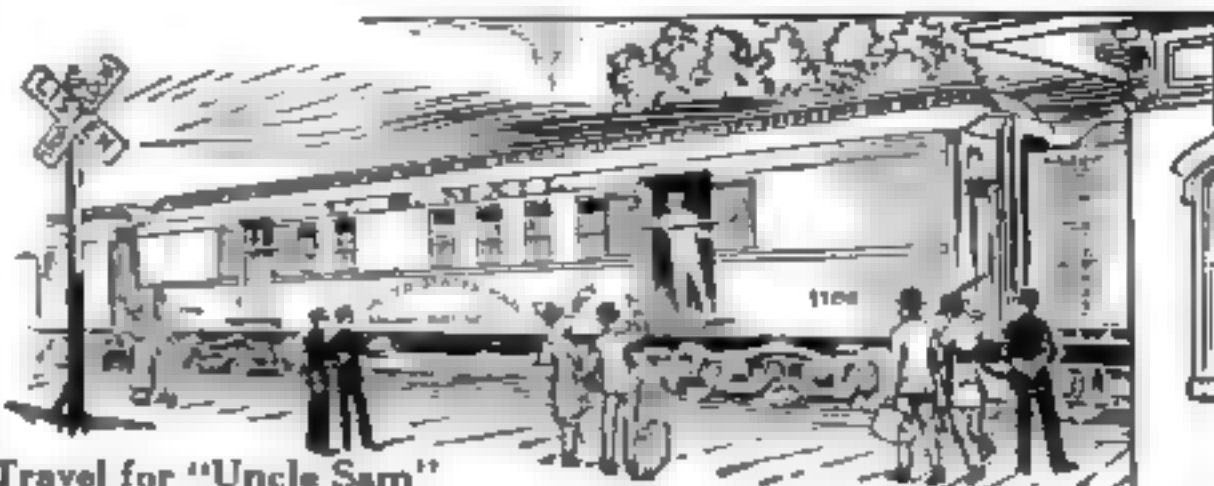
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Can You Say What You Mean?

(Continued from page 38)

past and study their changing shades of meaning.

Words are living things. Like mankind, language has evolved from primitive beginnings. Many of the words now in common use are traceable to the dawn of history. Countless words have been discarded, having outlived their usefulness. Some, newly born, are just beginning to find a place in the world; others are in full vigor of usefulness; still others are decaying of old age. But in every one lies a romantic history, from which it is possible to gain a clear idea of its true meaning.

NOT long ago most people took it for granted that man was created with a capacity for speech already fully formed in him, and with a language at his command. It was even supposed that this language was Hebrew, and that it was universal until the destruction of the Tower of Babel resulted in a diversity of tongues. Through the study of animals, children and primitive peoples and of the early records of the human race, this old idea has given place to the conclusion that language began with instinctive physiological exclamations—cries of pain, pleasure, recognition and the like. Moreover, the very first stages of speech, it is now believed, were imitations of sounds, man's original vocabulary consisting of words like "bang," "ham," and "rum."

From such primitive sounds, it has been a long step to the expression of abstract ideas. In general it is true that abstract terms have been formed from concrete ones denoting things that have physical existence. In more than one country missionaries have had to invent words to express ideas like "truth," "trust," "love," "pity," "time," "speed," "number," "form," and "color," not to mention more difficult concepts like "God," "forgiveness," and "imagination."

A large proportion of the oldest words in all languages are names of animals, weapons, agricultural implements and processes, parts of the body, and the simple and necessary motions of man and of the elements. We have examples in words like "deer," "shield," "dig," "tongue," "tooth," "net," "wade," and "war." These words have more or less distant cousins in most of the so-called Indo-European languages, showing that their common verbal ancestors existed when the common human forefathers of most Europeans and Americans were living in one region.

WITH the advance of civilization, the number of things and ideas to be named increases and language increases correspondingly. The vocabulary of English has never, in the last four hundred years, been far behind the demands of life. English is the offspring of a marriage which took place in the eleventh century between Anglo-Saxon and Norman-French. It has at its disposal, therefore, a Germanic and a Latin heritage, upon either of which it can draw at will. But this very wealth is a temptation to carelessness and vagueness in expression.

How difficult in this matter of precision is shown by the fact that the latest unabridged dictionary contains 453,000 words including, of course, such closely related words as "be" and "him," "bring" and "brought," as well as provincialisms and words no longer spoken but employed only by learned poets. And it is a matter of dispute whether there are any real synonyms in our language, that is, whether any two words have always precisely the same signification, color and power of suggestion.

Moreover, a large proportion of the 453,000 words have several meanings or shades of meaning and usage. Take the simple and much used Anglo-

(Continued on page 148)



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Can You Say What You Mean?

(Continued from page 145)

harvest, such as *banes*, *maffe* and *martingale*. Some words have fallen from a high to a low estate. "Silly," which now has only a bad connotation, once meant "brave" and we read in old poems of "the silly maids that sit about God's throne." Then, since perfectly good people are innocent and simple-hearted, it came to mean that, and we read of "silly babes" and "silly sheep" and so on down through a gradual degeneration. "Low" originally meant "of the people," "popular," "common" in a good sense. It is a well-known law of language that when a word has both an honorable and a dishonorable meaning, the latter drives out the former, because people are afraid of being misunderstood. "Simple" and "common" are in this state at the present. "vulgar" has already slipped over the edge, though we can ill afford to lose these necessary words in their good sense.

SINCE most men who are neither mathematicians nor deaf mutes can hardly think at all except through the medium of words, spoken or unspoken, it is usually possible to measure the contents of a man's mind by the number and character of the words in his possession. A man of no training and very limited experience can get along with 500 words. The average man requires several thousand, while the man of superior observation, wide activity and much reading goes far beyond the average. Command of words gives us mastery of men. When we can say exactly what we mean we have a good chance of obtaining a hearing. Without being glib or eloquent, a man wins respect for his intelligence by using language that is appropriate and powerful.

The chief difficulty nowadays is not that there are too few words available for our use, but that there are too many, and some of them unfit for the use we put them to. The most fearful of them all are the swaggering substitutes for good unpretentious terms already in use. For example, when we first heard "a paying proposition," the phrase had the air of a certified check. What was meant was perhaps merely a good plan. But "proposition" means a statement, not a plan nor a proposal. We were similarly fooled by "balance" as a swaggering substitute for remainder or rest. It gave us a feeling of having money in the bank, which would properly be called a balance.

In H. W. Fowler's "Dictionary of Modern English Usage" was published last year I supposed that certain devastating diseases of language were peculiar to the students whom I was teaching, and my relief was great when I found them nearly all noted in that entertaining book as widespread evils, not only in America but in England. I will bring together in one alphabetical sentence eleven specimen cases. Of course, no such monster ever roamed, but the component parts crawl everywhere. Here it is:

"DUE to the fact that my viewpoint was seldom ever equally as correct as his, he could not help but arise my sympathy when I jumped up the bust, shouting 'Alright' while he leaned out the window in back of the porch and protested my conduct."

Eleven errors are exemplified in that sentence. "Due" is an adjective and should not be used as a conjunction even when followed by "to." It is correct to say, "His illness was due to overeating," but not "He was ill, due to overeating." A bank protests a note, but we protest against an action. The other mistakes call for no explanation, and the sentence should read:

"Owing to the fact that my point of view was seldom as correct as his, he could not but (or could not help)" (Continued on page 150)



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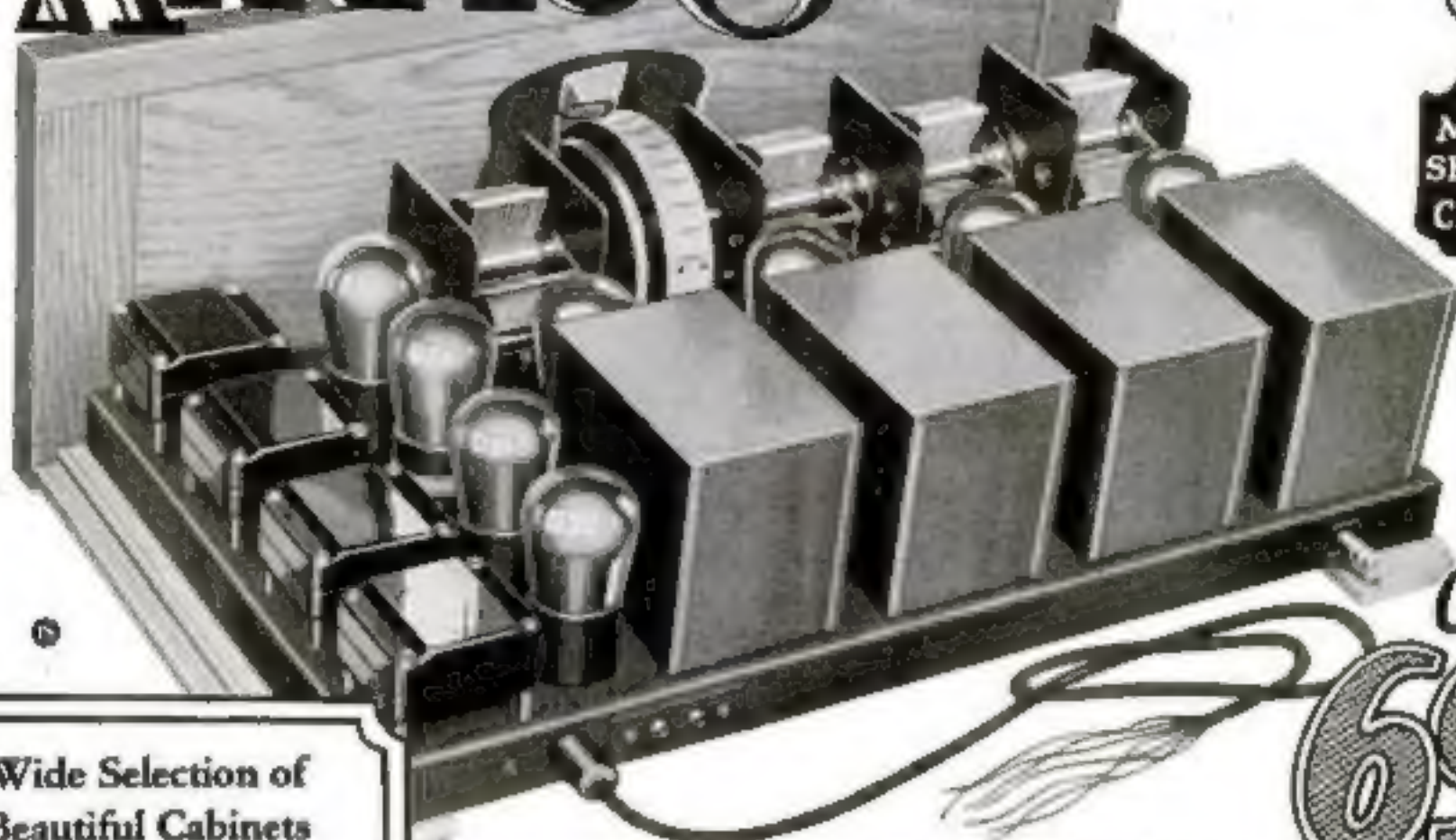
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Spanish treasure chest console, a beautiful walnut cabinet with large tone chamber.

Amazing New A C radio tubes eliminate batteries by use of electric house current

NEW RADIO TUBES TO USE ORDINARY HOUSE CURRENT FOR POWER

NEW YORK, Jan. 3rd.—Much interest was aroused in radio circles today by the announcement that a radio tube had at last been perfected which used ordinary electric house current in the operation of its plate circuit.

ELECTRICAL WIZARD RUNS RADIO WITH ORDINARY HOUSE LIGHTING CURRENT

NEW RADIO TUBE WILL OBSOLETE BATTERY POWER

WASHINGTON, Mar. 4.—It is who from the U. S. Dept. of Commerce have waited for the announcement of the new tube.

CROSLLEYAC BANDBOX
6 tubes

in the

Genuine Neutrodyne

STORIES in regard to the coming of AC tubes which would operate from house-lighting circuits have appeared in various newspapers, arousing a climax of anticipation in the public mind last spring.

With the acquisition of a license by the Crosley Radio Corporation under a large group of patents controlled by the Radio Corporation of America, American Telephone and Telegraph Company, General Electric Company, Westinghouse Electric and Manufacturing Company, etc., the Crosley AC Bandbox is possible through the use of the new R.C.A. alternating current tubes, UX226 and UY227. These tubes utilize for their filaments and heating regular alternating current from the house-lighting circuit.

The current is stepped down by means of a transformer without need of rectifiers to supply the heat necessary for the functioning of the tubes. The converter box, which is included with the Crosley AC Bandbox can be tucked away out of sight. It is connected to the Bandbox by a cable and also supplies the current for the plate voltages on the tubes replacing B batteries.

Thus the Crosley AC Bandbox functions entirely from the regular house-lighting current without need of batteries, battery

chargers, or any of the other usual paraphernalia which requires attention, care and early replacement.

The Crosley AC Bandbox with the new alternating current tubes is truly revolutionary, and brings to the radio user an entirely new conception of care-free radio. This AC model together with the battery type BANDBOX which works with standard power supply units and storage batteries is the country's most talked of radio! The popularity centers around two major factors:

1. The impending array of patents under which it is built.

2. The number and quality of the features Powel Crosley, Jr., has built in it for the price!

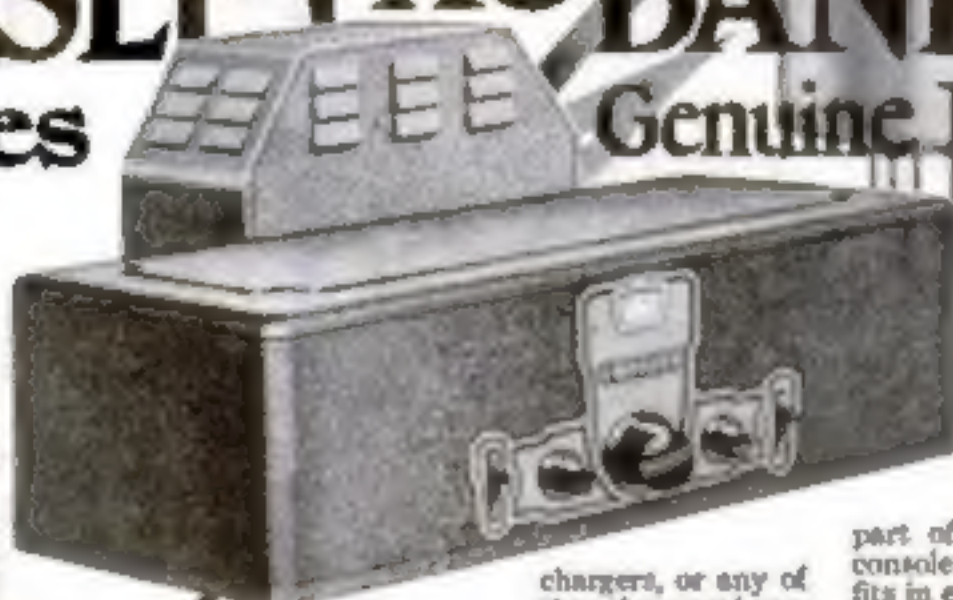
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3. Volume control.
4. Accumulators for sharpest tuning.
5. Single cable connections.
6. Single station selector.
7. Illuminated dial.
8. Adaptability to ANY type installation.

Today's radio must be adaptable to the

Montana, Wyoming, Colorado, New Mexico and West, prices slightly higher.

Now \$110 without tubes



NEUTRODYNE

home. It must fit into all kinds of conditions. Perhaps you have a bookcase corner—a desk compartment—a chest—or even a bureau drawer where it could be tucked away. Maybe you want it to be

part of the furnishings, as an impressive console or credenza cabinet. The Bandbox fits in everywhere.

The metal outside case is easily and quickly removed.

The set is solidly mounted on a stout steel chassis. As all controls are assembled together in the front, cabinet panels are easily cut to allow their protrusion. The metal escutcheon is screwed on over the shafts and the installation has all the appearance of being built to order.

Two large furniture manufacturers have designed console cabinets in which the Bandbox can be superbly installed. (Shower Bros. Mfg. Co., of Bloomington, Ind., and the Wolf Mfg. Co. of Kokomo, Ind.) Powel Crosley, Jr., has approved them mechanically and acoustically and has seen to it that the famous Crosley Musicnotes are built in them so that the best type of loud speaker reproduction may be insured.

This is the kind of a radio you have been waiting for—the real direct electric set that requires absolutely no attention. What if it does run all night! Win wars! No run down batteries greet you in the morning. You owe it to yourself to see the Bandbox and listen to its remarkable performance. If you cannot easily locate the nearest Crosley dealer, his name and address will be supplied on request. Write Dept. 17.



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